Intro to Small Unmanned Aircraft Systems & Recreational Drones

Part 107 FAA Remote Pilot Test

Requirements for flying under the FAA small UAS rule (14 CFR part 107).		
Pilot must be 16 years old or older	Able to read, write, speak and understand English	Be in a physical and mental condition to safely fly a UAS

Part 107 FAA Tests

Requirements for flying under the FAA small UAS rule (14 CFR part 107).

You must pass a formal aeronautical knowledge test – $175

The Transportation Safety Administration (TSA) background check – $40

License must be renewed every 2 years - FAA will notify you by email when due for a recurrent test

Part 107 FAA Remote Pilot Test

Step #1

- Obtain an FAA Tracking Number (FTN) by creating an **Integrated Airman Certification and Rating Application (IACRA)** profile prior to registering for a knowledge test. Click on “Register” and complete the form.

https://iacra.faa.gov/IACRA/

Step #2

- Schedule an appointment with a FAA-approved Knowledge Testing Center. Be sure to bring a government-issued photo ID to your test.

Step #3

Part 107 FAA Remote Pilot Test

Testing Location –

Hawkeye Community College

Black Hawk Hall

1501 E Orange Rd, Waterloo, IA 50701

Phone (319) 296-4014

"Unmanned Aircraft General – Small (UAG)"

- PSI is the FAA's official testing partner. They offer FAA Airman Knowledge Tests (AKT) at many locations nationwide.
- You can find a nearby location at https://faa.psiexams.com/faa/login
- The Exam is **"Unmanned Aircraft General – Small (UAG)"**

Step #4: Complete FAA Form 8710-13 for a remote pilot certificate

- Login to the **Integrated Airman Certification and Rating Application (IACRA)** with your username and password
- Click on **"Start New Application“**
  - 1) Application Type **"Pilot"**
  - 2) Certifications **"Remote Pilot“**
  - 3) Other Path Information
  - 4) Start Application
- Enter the 17-digit Knowledge Test Exam ID

  (Note: it may take up to 48 hours from the test date for the knowledge test to appear in IACRA)
- Sign the application electronically and submit for processing.

Step #5: A confirmation email will be sent when the TSA security background check is completed. This email will provide instructions for printing a copy of the temporary remote pilot certificate from IACRA.

You may now fly using the temporary remote pilot certificate.

Step #6: A permanent remote pilot certificate will be sent via mail once FAA-internal processing is complete.

FAA Remote Pilot License

Always carry your Remote Pilot License with you when you fly.

Alternate Part 107 qualification

If you already have a **Part 61 pilot certificate**, other than a student pilot certificate, you can take a small UAS online training course provided by the FAA. You must have completed a flight review in the previous 24 months.

Part 61 pilot certificates include sport pilot, recreational pilot, private pilot, commercial pilot and air transport pilot certificates.

Part 107 Remote Pilot Certificate

438,673 Part 107 Remote Pilot Certificates have been issued. (March 2025)

412,505 drones registered for commercial use

84% of individuals who took the Part 107 aeronautical knowledge exam passed with an average score of 80% correct.

Part 107 Test Topics

	Percentage	Questions
I. Regulations	48%	29
II. Airspace	20%	12
III. Weather	5%	3
IV. Loading & Performance	2%	1
V. Operations	25%	15
Total Number of Questions		**60**

Passing score of 70% (42 correct)

120 minutes to complete the exam

I. Regulations

- Regulations relating to small unmanned aircraft system rating privileges, limitations and flight operation

II. Airspace

- Airspace classification and operating requirements, and flight restrictions affecting small unmanned aircraft operation – Sectional Chart reading

III. Weather

- Aviation weather sources and effects of weather on small unmanned aircraft performance

IV. Small unmanned aircraft loading and performance

- Determining the performance of small unmanned aircraft

V. Operations

- Crew Resource Management (CRM), decision making, radio & airport operations, emergency procedures

Part 107 Recurrent Test

Your Part 107 Remote Pilots Certificate never expires, but you must take the FAA's online Recurrent Test every 24 months.

The Recurrent Test covers the following areas:

- **Regulations**
- **Airspace**
- **Operations**

No questions on:

- **Weather**
- **Loading & Performance**

The test is free with a passing score of 100%. The test will highlight wrong answers in red. You redo the test until there are no wrong answers.

FAA Aeronautical Test

I. **FAA Rules** – 29 questions

Applicable regulations relating to small unmanned aircraft systems, operational limits, Remote Pilot in Command (Remote PIC), Visual Observer (VO)

Pilot in Command (PIC)

The **Pilot in Command** (PIC) must have a current FAA Remote Pilot License.

Pilot in Command (PIC)

The remote pilot in command:

- must ensure that the small unmanned aircraft poses **no undue hazard** to people, property, or other aircraft in the event of a loss of control of the drone.
- is **directly responsible** for and is the **final authority** for the operation of the drone.
- may designate a **drone operator** to fly and control the drone.

Why use a Visual Observer (VO)?

The Pilot keeps a continuous eye on the drone while the Visual Observer continuously scan the airspace where the drone is operating for any potential collision hazards.

The Visual Observer must be in continuous communication with the Pilot in Command.

§ 107.33 - Visual Observer (VO)

The remote pilot in command (PIC) must ensure that the visual observer is always able to see the unmanned aircraft with unaided eyesight and maintain awareness of the position of the drone through direct visual observation.

See and Observe

The Remote Pilot or Visual Observer need to continuously scan the sky to see and observe other aircraft. If you take you eye off of a drone flying at high altitude, you may not be able to quickly regain sight of the drone. Therefore, the pilot can keep a continuous eye on the drone while the visual observer scans the sky.

The Remote Pilot or Visual Observer should:

(1) know the unmanned aircraft's location;

(2) determine the unmanned aircraft's attitude, altitude, and direction;

(3) observe the airspace for other air traffic or hazards; and

(4) determine that the unmanned aircraft does not endanger the life or property of another.

Sample Test Question

When may a person who does not hold a remote pilot certificate operate a drone for hire?

1) Only when the flight operations have been approved by a certified sUAS pilot
2) When under the direct supervision of a certified remote PIC who is immediately available to take control if necessary
3) When directly supervised by a Visual Observer (VO)

Sample Test Question

When may a person who does not hold a remote pilot certificate operate a drone for hire?

1) Only when the flight operations have been approved by a certified sUAS pilot
2) **When under the direct supervision of a certified remote PIC who is immediately available to take control if necessary**
3) When directly supervised by a Visual Observer (VO)

Sample Test Question

A small UAS must be operated in a manner which:

A) does not endanger the life or property of another.

B) requires a visual observer.

C) never exceeds 400 feet AGL

Sample Test Question

A small UAS must be operated in a manner which:

A) **does not endanger the life or property of another.**

B) requires a visual observer.

C) never exceeds 400 feet AGL

All these answers are or could be true, but “A” is the most important.

Sample Test Question

You plan to release golf balls from your drone at an altitude of 100 feet AGL. You must ensure the objects being dropped will:

A) not create an undue hazard to persons or property.

B) land within 10 feet of the expected landing zone.

C) not cause property damage in excess of $300.

Sample Test Question

You plan to release golf balls from your drone at an altitude of 100 feet AGL. You must ensure the objects being dropped will:

A) not create an undue hazard to persons or property.

B) land within 10 feet of the expected landing zone.

C) not cause property damage in excess of $300.

§107.23(b), *"No person may allow an object to be dropped from a small unmanned aircraft in a manner that creates an undue hazard to persons or property."*

FAA Aeronautical Knowledge Test

Part 107 Test

Weather – 3 questions

a) Aviation weather sources and effects of weather on small unmanned aircraft performance

b) Must understand Meteorological Aerodrome Report (METAR) and Terminal Aerodrome Forecast (TAF) weather forecast code

METAR: KALO 101954Z 30010KT 10SM CLR 02/M08 A3033 RMK AO2 SLP284 T00171083

Aviation Weather Reports

- **Meteorological Aerodrome Report** (METAR)
- **Terminal Aerodrome Forecast** (TAF)
- **Automatic Terminal Information Service** (ATIS)
- **FAA Flight Service Station** (FSS)
  www.1800wxbrief.com – Fort Dodge
- **NOAA Weather Service Office –** Des Moines
- **Pilot's Automatic Telephone Answering Service** (PATWAS)
- **Telephone Information Briefing Service** (TIBS).
- **Automated Surface Observing Systems** (ASOS)
- **Automated Weather Observing System** (AWOS) is an older system

METAR vs. TAF

METAR (Meteorological Aerodrome Report) reports current conditions including precipitation accumulations.

- **AO1** indicates stations without a rain/snow sensor.
- **AO2** indicates station with rain/snow sensors.

TAF (Terminal Aerodrome Forecast) is a weather prediction for the next 24 hours.

Both use the same format

KALO METAR

KALO 101954Z 30010KT 10SM CLR 02/M08 A3033 RMK AO2 SLP284 T00171083

METAR for: KALO (Waterloo Rgnl, IA, US)
Date & Time: 1954 UTC 10 Nov 2025 (1:54 PM)
Winds: from the WNW (300°) at 10 kt (11.5 mph)
Visibility: 10+ mi (16+ km) and Clear (no clouds)
Temperature: 1.7°C (35°F)
Dewpoint: -8.3°C (17°F) (RH = 47%)
Pressure (altimeter): 30.33 inHg (1027.2 hPa) (sea level pressure 1028.4 hPa)

TAF

TAF KALO 101720Z 1018/1118 32010KT P6SM FEW028
Forecast period: 1800 UTC 10 Nov 2025 to 1900 UTC 10 Nov 2025 (noon to 1:00 PM)
Winds: from the NW (320°) at 10 kt (11.5 mph)
Visibility: 6+ mi (10+ km)
Clouds:few clouds at 2,800 ft
FM101900 30009KT P6SM SCT030
Forecast period: 1900 UTC 10 Nov 2025 to 0000 UTC 11 Nov 2025 (1:00 PM to 6:00 PM)
Winds: from the WNW (300°) at 9 kt (10.4 mph)
Visibility: 6+ mi (10+ km)
Clouds:scattered clouds at 3,000 ft

TAF

FM110000 23009KT P6SM FEW030 SCT250
Forecast period: 0000 UTC 11 Nov 2025 to 0900 UTC 11 Nov 2025 (6:00 PM to 3:00 AM tomorrow)
Winds: from the SW (230°) at 9 kt (10.4 mph)
Visibility: 6+ mi (10+ km)
Clouds: few clouds at 3,000 ft, scattered clouds at 25,000 ft
FM110900 19011KT P6SM BKN200 WS020/22040KT
Forecast period: 0900 UTC 11 Nov 2025 to 1400 UTC 11 Nov 2025 (3:00 AM to 8:00 AM tomorrow)
Winds: from the S (190°) at 11 kt (12.7 mph)
Visibility: 6+ mi (10+ km)
Clouds:broken clouds at 20,000 ft
Wind Shear at 2,000 ft
Winds: from SW (220°) at 40 kt (46 mph)

TAF

FM111400 23012KT P6SM SCT200
Forecast period: 1400 UTC 11 Nov 2025 to 1800 UTC 11 Nov 2025 (8:00 AM to 12:00 PM)
Winds: from the SW (230°) at 12 kt (6.2 m/s, 13.8 mph)
Visibility: 6+ mi (10+ km)
Clouds:scattered clouds at 20,000 ft

“FM” From (standard forecast or significant change)
"BECMG" Becoming = gradual change
"TEMPO" Temporary = less then one hour or less than ½ the forecast period

Common METAR/TAF Abreviations

Modifiers:
- Light
+ Heavy
P More than (Plus)
M Less than
B Began
E Ended

Weather Identifiers:
BC Patches (banc = fog bank)
BL Blowing
BR Mist (Brume meaning mist)
DZ Drizzle
FC Funnel Cloud
FG Fog
FU Smoke
FZ Freezing
GR Hail
HZ Haze
PR Partial
RA Rain
SG Snow Grains
SH Showers
SN Snow
TS Thunderstorm

Sky Conditions:
BKN – Broken clouds
CB – Cumulonimbus
CLR – Sky clear below 12,000 AGL
FEW – Few clouds
OVC – Overcast coverage
SCT – Scattered cloud
SKC – Sky Clear
TCU – Towering Cumulus

Common METAR/TAF Abbreviations

Other:

BECMG – Becoming

CAVU – Ceiling And Visibility Unlimited

COR – Correction

FM – From

LTG – Lightning

M – Minus, less than, below zero

NSW – No significant weather

P6SM – Plus 6 Statute Miles, “more than 6 miles”

PROB40 – Probability of 40%

RMK – Remarks

SLP – Sea Level Pressure

SM – Statute miles

TEMPO – Temporarily

V – Varying

VRB – Variable

WS – Wind shear

Automatic Terminal Information Service (ATIS)

ATIS continuously broadcasts current weather and routine information to arriving and departing aircraft such as runways in use and surface conditions.

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ACARS BEGIN - 18/08/01 00:12:22

18/08/01   00:12:07   OPEN

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ATIS EDDK N METAR 312350
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T20 DP14
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ACARS END
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Local Airport Advisory (LAA)

Local Airport Advisory (LAA) is a service provided by a Flight Service Station (FSS), which is located on or near the landing airport. Communication is by a ground-to-air communications frequency or the tower frequency when the tower is closed. Data includes automated weather reporting with a voice broadcast, continuous ASOS/AWOS data, other direct reading instruments, or manual observations available to the FSS specialist.

Sample Test Question

The METAR weather conditions at KALO are:

KALO 071654Z 30013G18KT 10SM OVC039 12/02 A3025

A) Wind from 300° at 13 Knots, Visibility of 10 statute miles, Overcast clouds at 3900 feet, Temperature of 12°C/Dew point of 2°C, Barometer 30.25 In Hg.

B) Wind from 300° at 13 Knots, Visibility of 10 statute miles, Overcast clouds at 3900 feet, Temperature of 12°C/Dew point of 2°C, Barometer 30.25 mb.

C) A) Wind from 300° at 13 Knots, Visibility of 10 statute miles, Overcast clouds at 39000 feet, Temperature of 12°C/Dew point of 2°C, Barometer 30.25 In Hg

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Sample Test Question

The METAR weather conditions at KALO are:

KALO 071654Z 30013G18KT 10SM OVC039 12/02 A3025

A) The wind is from 300° true at 13 Knots

B) The wind is from 300° magnetic at 13 Knots

C) The wind is from 130° true at 30 Knots

D) The wind is from 130° magnetic at 30 Knots

Sample Test Question

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KALO 071654Z 30013G18KT 10SM OVC039 12/02 A3025

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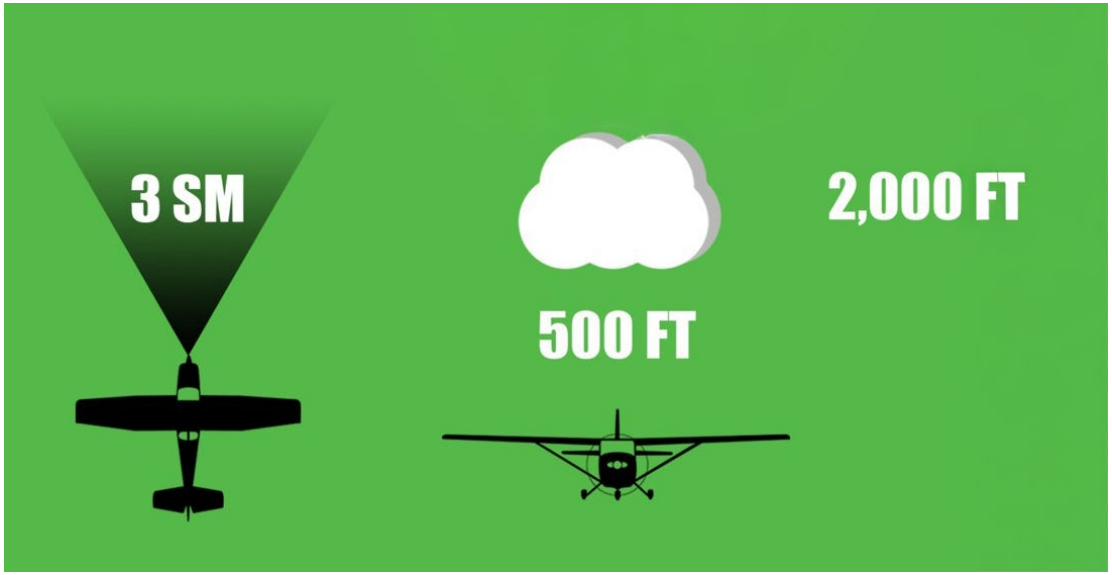
B) The wind is from 300° magnetic at 13 Knots
C) The wind is from 130° true at 30 Knots
D) The wind is from 130° magnetic at 30 Knots

"If it's in print it's true."

Runways and VOR compass roses are magnetic.

Weather

- **The FAA requires at minimum of 3 statute mile visibility**
- **Minimum distance from clouds of no less than 500 feet below a cloud and no less than 2000 feet horizontally from any cloud**



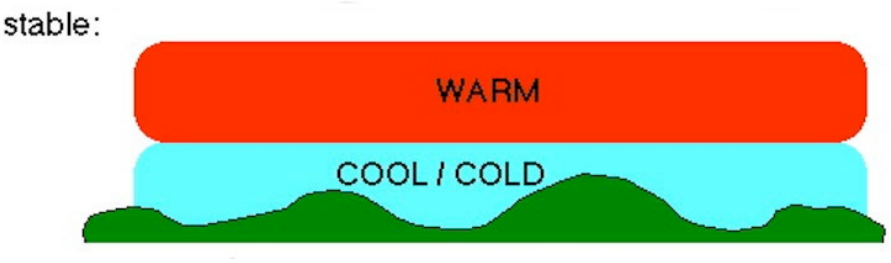
Weather

Flying in snow, fog, rain or other reduced visibility conditions is not recommended!

Wind

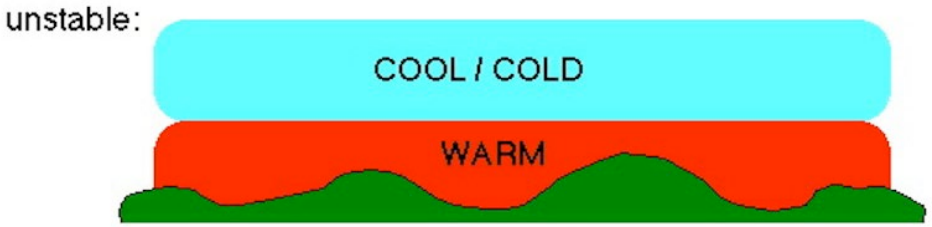
- **Do not fly in conditions where gusts may exceed your drone's top speed, not just the average wind speed. The average wind might be 20 MPH, but there may be gusts up to 40 MPH.**
- **Use Common Sense!**

Stable Air



- Stable air tends to produce widespread low, flat clouds that cover most or all the sky. This happens when warm air flows over cold air ahead of a surface warm front.
- Any rain or snow will be steady, but not heavy.
- Visibility is likely to be poor with a low ceiling.
- It's a "gloomy weather" day.
- The one good fact for pilots is that the air will tend to be smooth with little turbulence.
- An "inversion", when air temperature increases with altitude, produces the most stable air. It acts like a lid to keep poor visibility or foggy air from rising and being replaced by cleaner air from aloft.

Unstable Air



- When air rises, we say it's unstable.
- There's a good chance of puffy, towering, cumulus clouds and maybe thunderstorms, if the air is humid.
- In unstable air, the clouds aren't likely to cover all of the sky all day.
- Rain or snow can be heavy and comes in showers.
- Away from the clouds, visibility is likely to be good.
- Fair-weather cumulus clouds often have unstable air beneath them.
- Dust devils are a sign of dry, unstable air.
- The most unstable days happen when cold, upper-air disturbances move over humid warm air.

Stable Air

- **Stable air –** Smooth air, poor visibility, and steady precipitation
- **Temperature inversion –** Warm air on top of cold air
- **Cool + Dry** = Stable
- Fog, haze, low clouds, poor visibility
- Gloomy day

Unstable Air

- **Hot + Humid** = Unstable
- **Moist, unstable air** – Turbulence (because the air is unstable)
- **Showers** or Intermittent precipitation.
- **Cumulus** – flat bottom with puffy top – turbulence underneath
- **Cumulonimbus** –a towering cloud with anvil top – severe turbulence and thunderstorms

Test Question

What are the characteristics of stable air?

A. Good visibility and steady precipitation.
B. Poor visibility and steady precipitation.
C. Poor visibility and intermittent precipitation.

Test Question

What are the characteristics of stable air?

A. Good visibility and steady precipitation.
B. **Poor visibility and steady precipitation.**
C. Poor visibility and intermittent precipitation.

Test Question

What are the characteristics of a moist, unstable air mass?

A. Turbulence and showery precipitation.
B. Poor visibility and smooth air.
C. Haze and smoke.

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A. **Turbulence and showery precipitation.**
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Test Question

You have received a weather briefing that indicates a low-level temperature inversion with high relative humidity. What weather conditions would you expect?

A. Smooth air, poor visibility, fog, haze, or low clouds.

B. Light wind shear, poor visibility, haze, and light rain.

C. Turbulent air, poor visibility, fog, low stratus type clouds, and showery precipitation.

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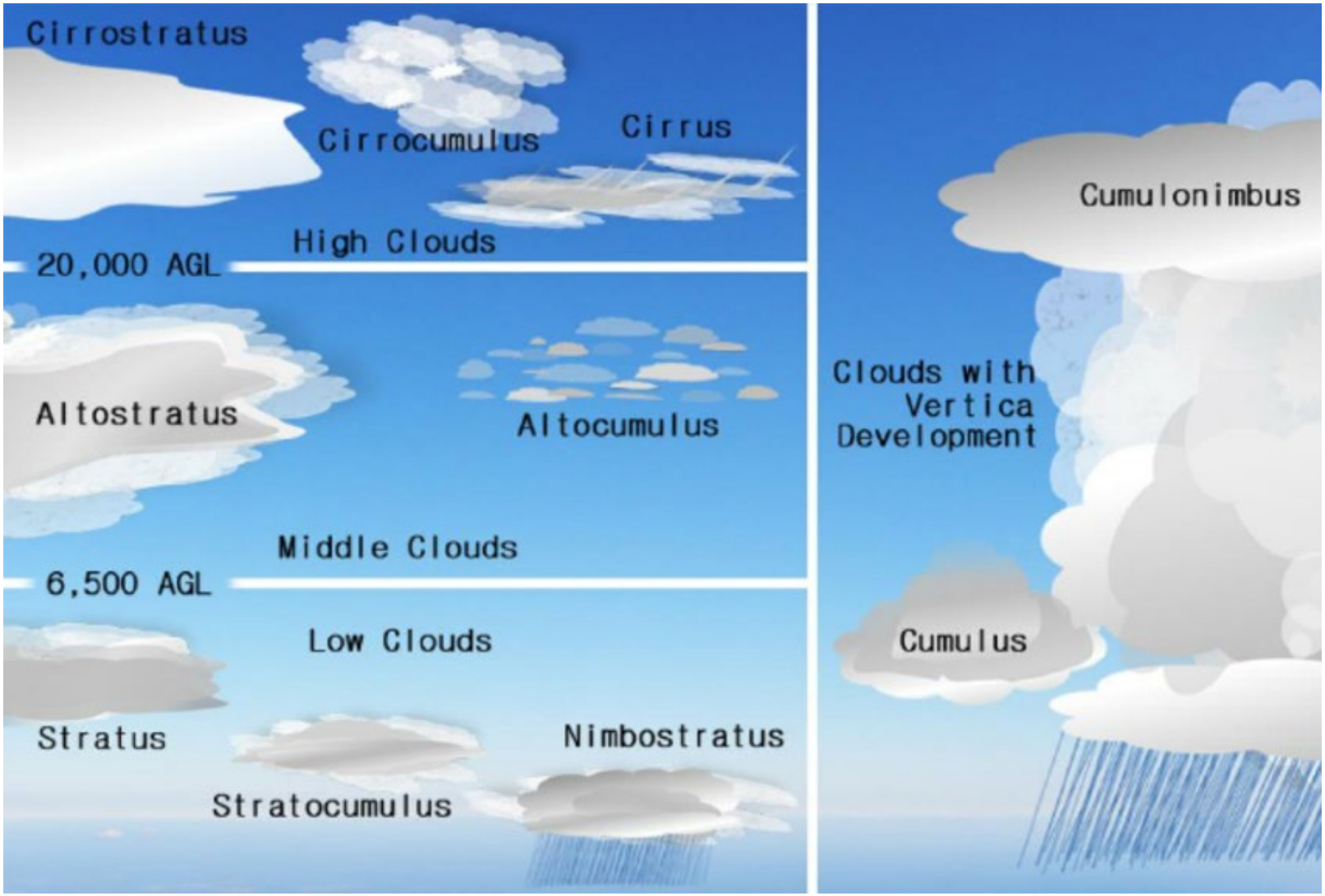
Cloud Types


Cirrostratus
Cirrocumulus
Cirrus
High Clouds
20,000 AGL
Altostratus
Altocumulus
Middle Clouds
6,500 AGL
Low Clouds
Stratus
Nimbostratus
Stratocumulus
Cumulonimbus
Clouds with
Vertica
Development
Cumulus

Dew Point

Dew Point is the temperature at which the air is saturated with moisture. The relative humidity is 100% and fog or a cloud form. The difference between the surface temperature and the dew point temperature determines the altitude at which the air cools to its saturation point and clouds begin to form.

- A **small temperature difference (3º-5º)** between surface temperature and dew point results in a **low cloud base**, as the air doesn't need to rise far to condense.
- A **large difference** leads to a **higher cloud base**, as the air must rise farther before cooling to the dew point.

The height of the cloud base can be found on various weather apps or it can be calculated using this formula:

Current Temperature – Dew Point = Spread. Divide the Spread by 4.4 (°F) or 2.5 (°C), then multiply by 1,000 to get the cloud base in feet AGL

Test Question

Which two factors can be used to compute the cloud base?

A. The temperature and the dew point
B. The temperature and the barometric pressure
C. The barometric pressure and the dew point

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A. The temperature and the dew point

B. The temperature and the barometric pressure

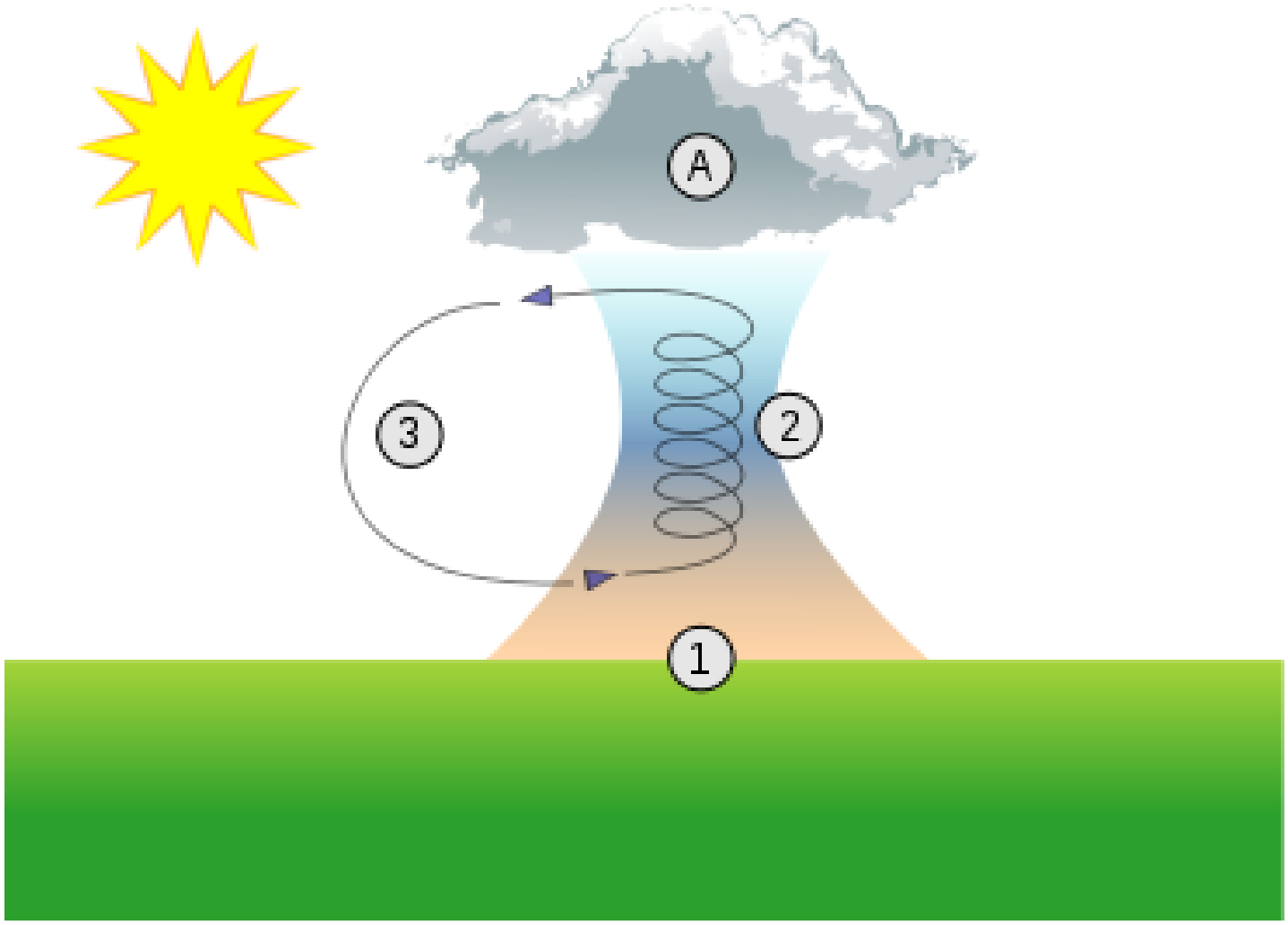
C. The barometric pressure and the dew point

Low Clouds (less than 6,500 feet)

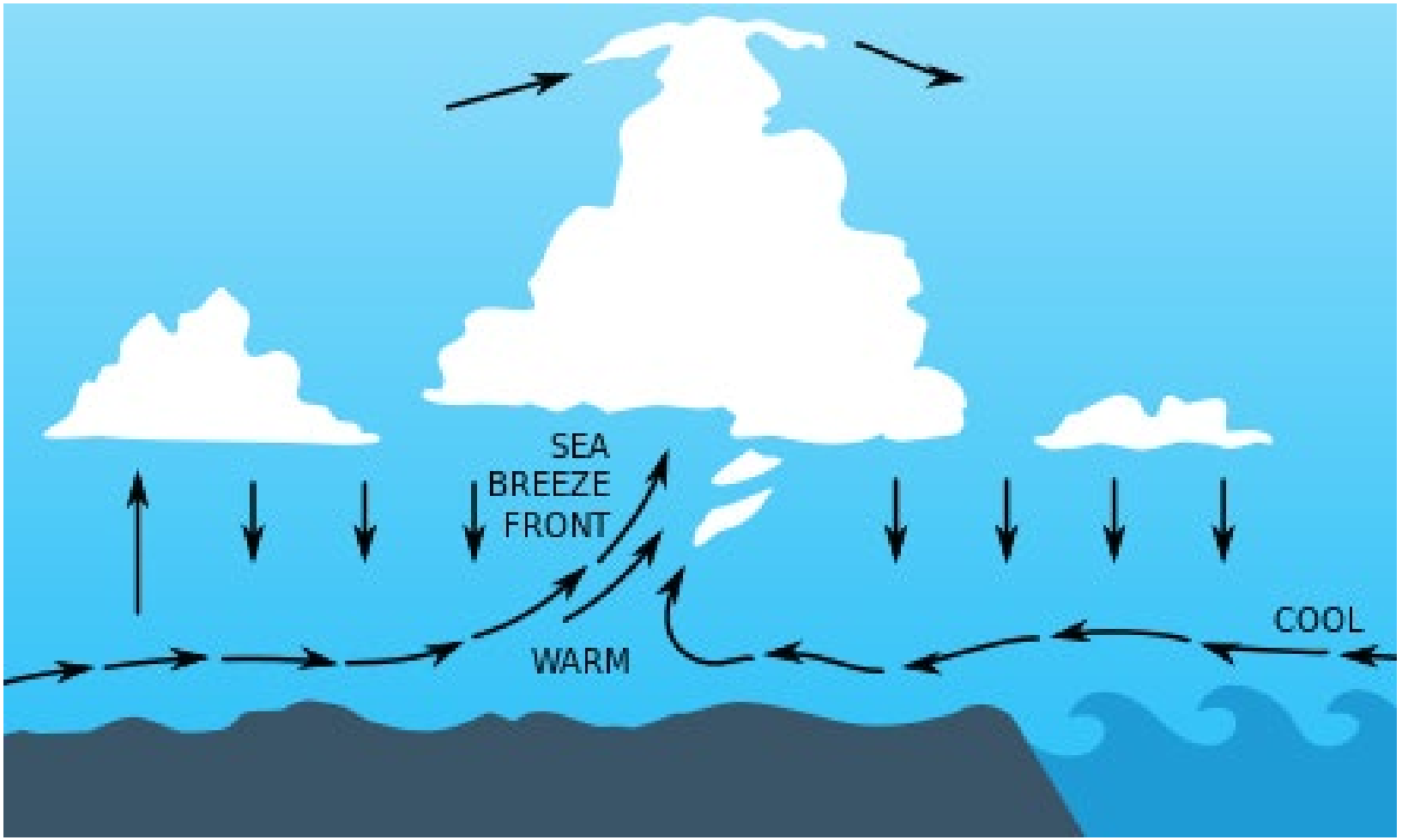
<u>Cumulus clouds</u> look like fluffy, white cotton balls in the sky.

Weather prediction: Fair

Thermal Column



Convergence Zone



Low Clouds (less than 6,500 feet)

<u>Stratus cloud</u> often look like thin, white sheets covering the whole sky. Since they are so thin, they seldom produce much rain or snow.

Weather prediction: Fair, but gloomy

Low Clouds (less than 6,500 feet)

<u>Cumulonimbus clouds</u> grow on hot days when warm, wet air rises very high into the sky.

Weather prediction: Look out for rain, hail, and tornadoes!

Low Clouds (less than 6,500 feet)

<u>Stratocumulus clouds</u> are patchy gray or white clouds that often have a dark honeycomb-like appearance.
Weather prediction: Fair weather for now, but a storm might be on its way.

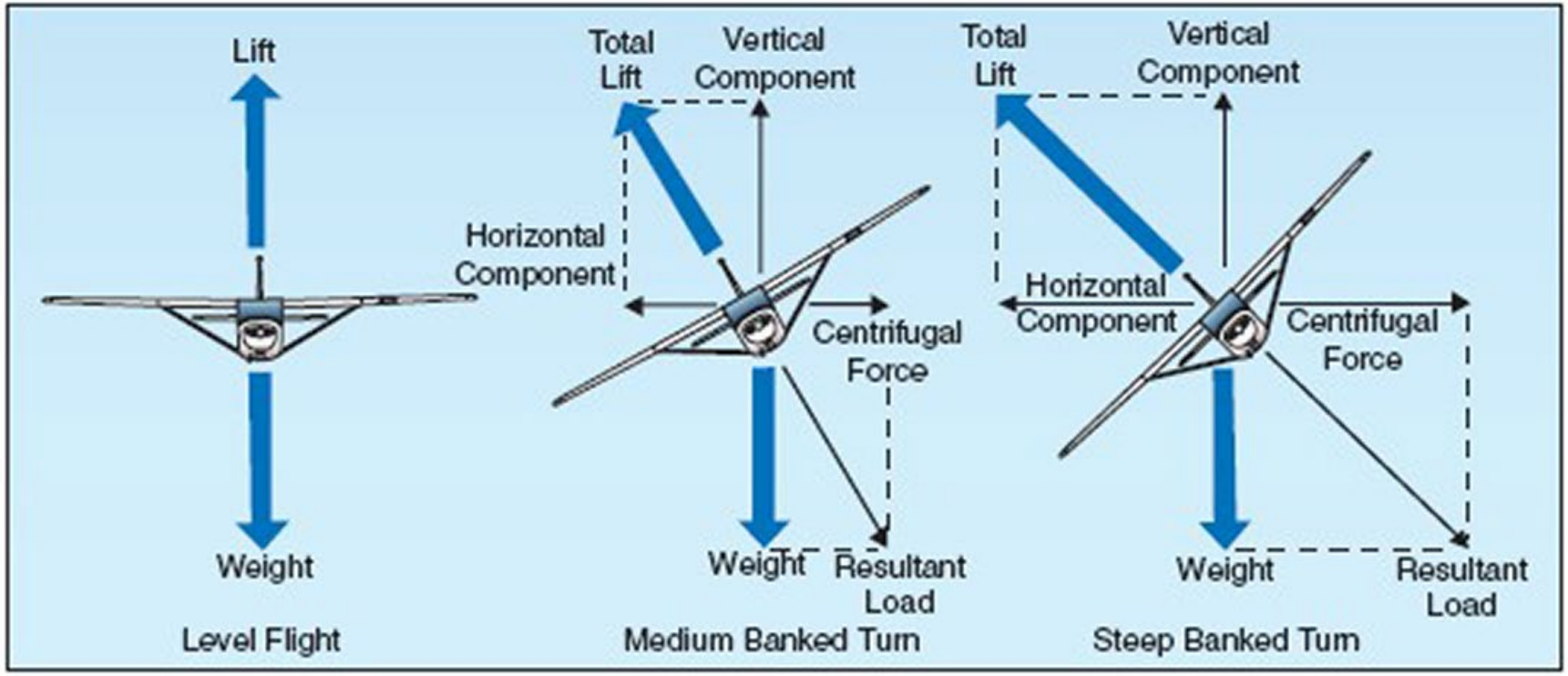
FAA Aeronautical Knowledge Test

Part 107 Test

Drone Loading & Performance – 1 or 2 questions

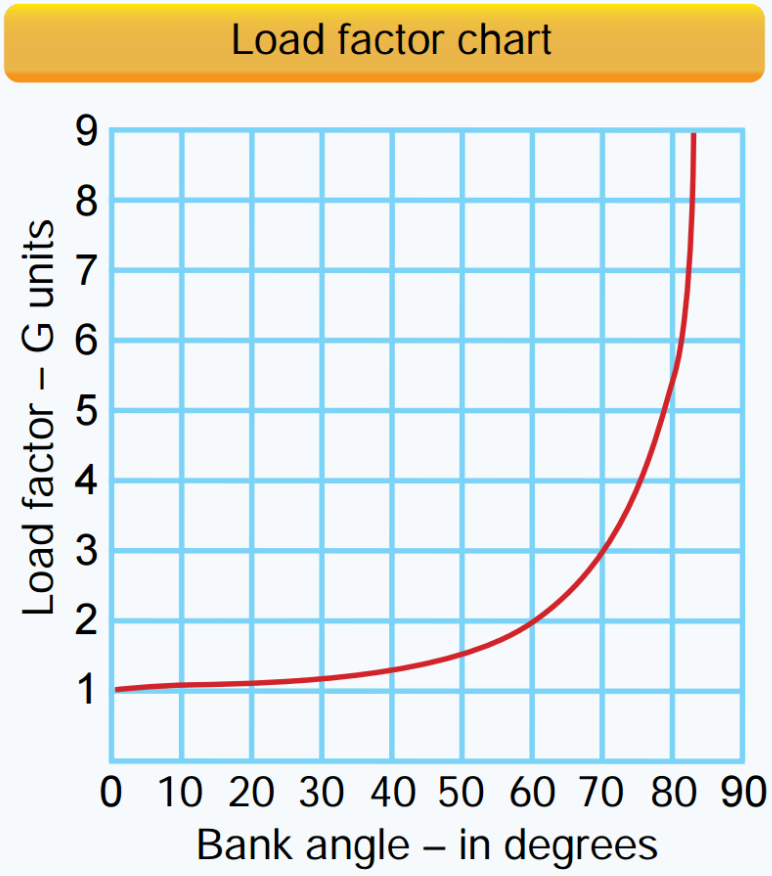
a) Small unmanned aircraft loading and performance
b) Determining the performance of small unmanned aircraft

Forces during a Turn



Load Factor

Angle of bank φ	Load factor n
0°	1.0
10°	1.015
30°	1.154
45°	1.414
60°	2.000
70°	2.923
80°	5.747
85°	11.473
90°	∞



Turns and aerobatic maneuvers increase the load and stress on various parts of the aircraft.

Sample Test Question

If the aircraft weighs 10 pounds fully loaded at takeoff, what is the g-load weight in a 45° banked turn?

Angle of bank Φ	Load factor n
0°	1.0
10°	1.015
30°	1.154
45°	1.414
60°	2.000
70°	2.923
80°	5.747
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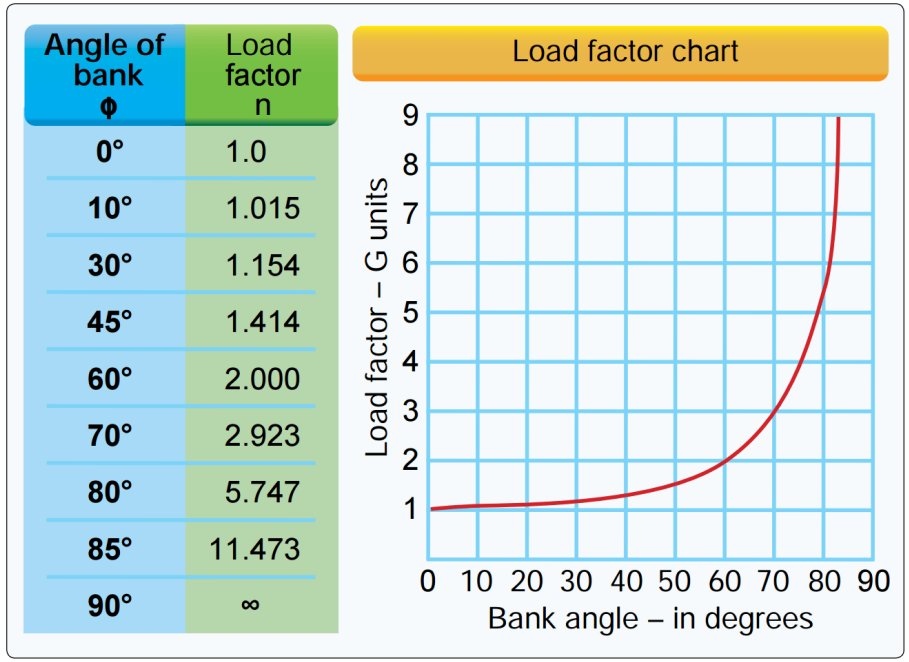

It still weighs 10 pounds

About 14.4 pounds

About 45.0 pounds

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0°	1.0
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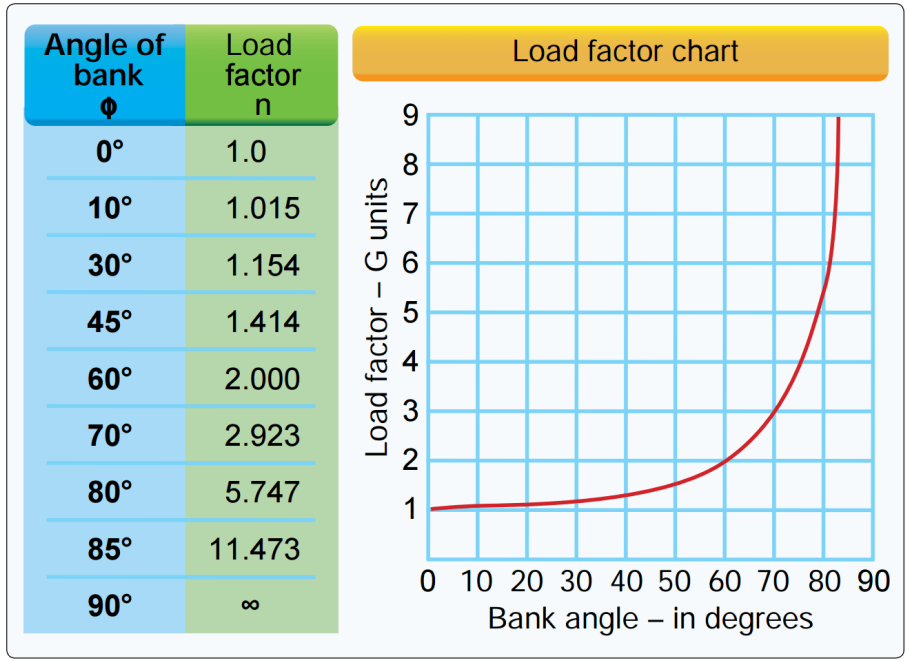

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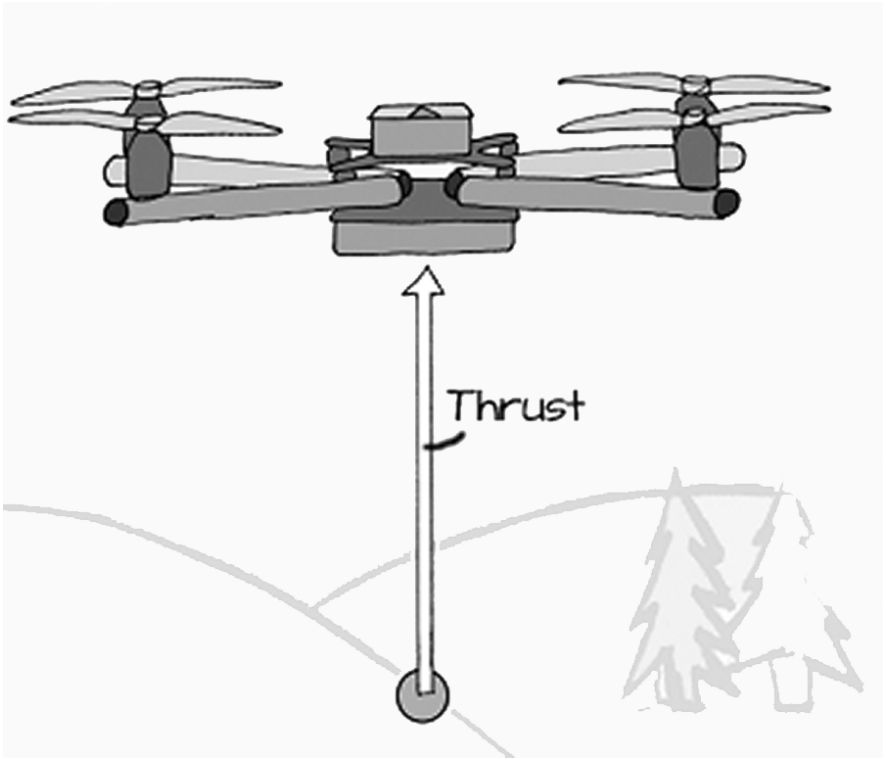
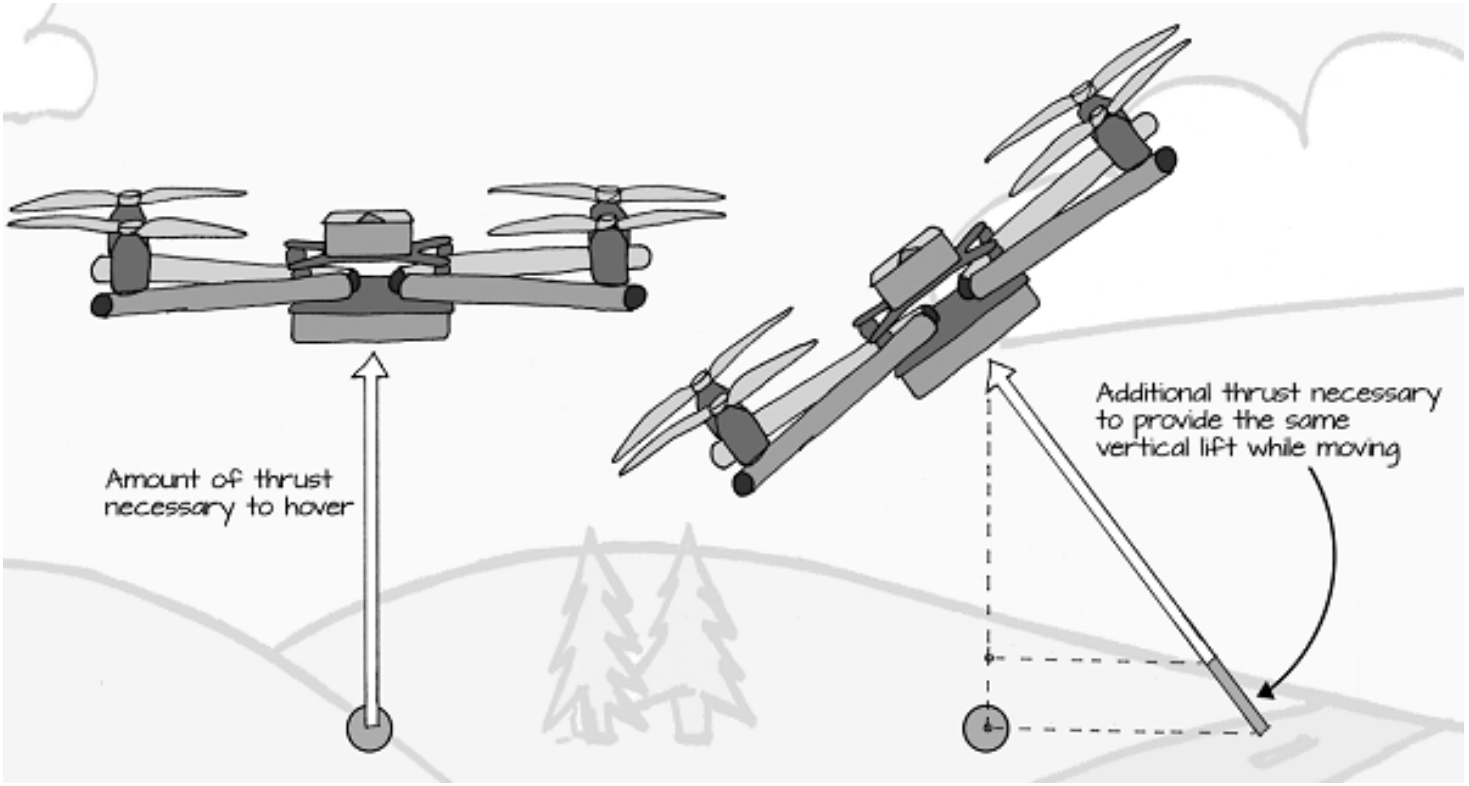
About 45.0 pounds

Quadcopter Performance



When a quadcopter is hovering, the only forces are Aerodynamic Thrust and Weight

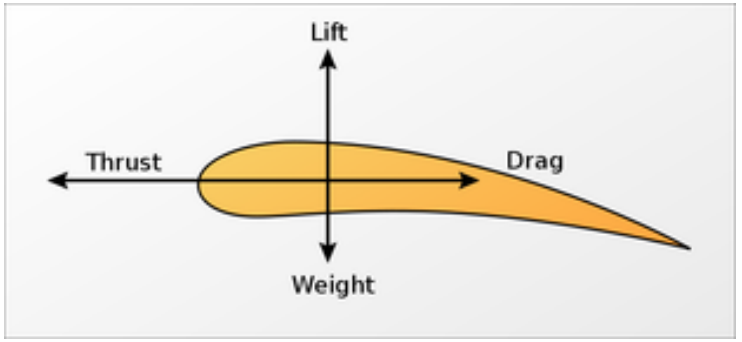
Quadcopter Performance



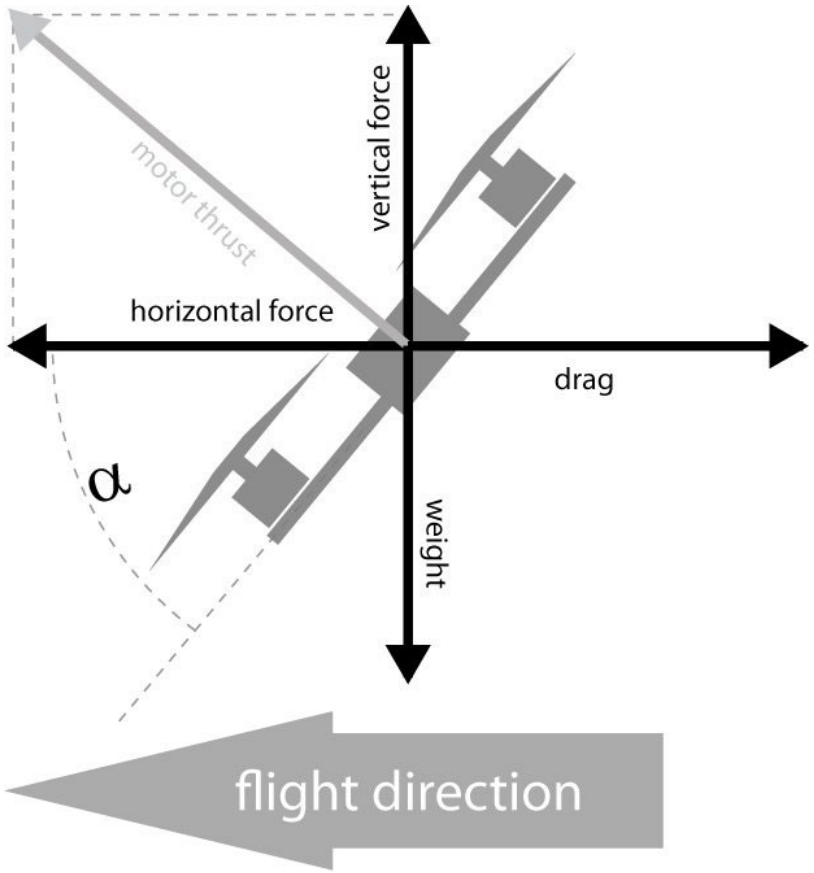
Flying forward would seem to require more power

Transitional Lift

Flying a quadcopter forward requires less power than hovering. This phenomenon is known as "helicopter translational lift". This seems counter-intuitive, but it's true. The forward motion provides airflow over the blades, which enhances the lift on the quadcopter. Therefore, forward flight is better for motor life and increases flight time.



Quadcopter Performance

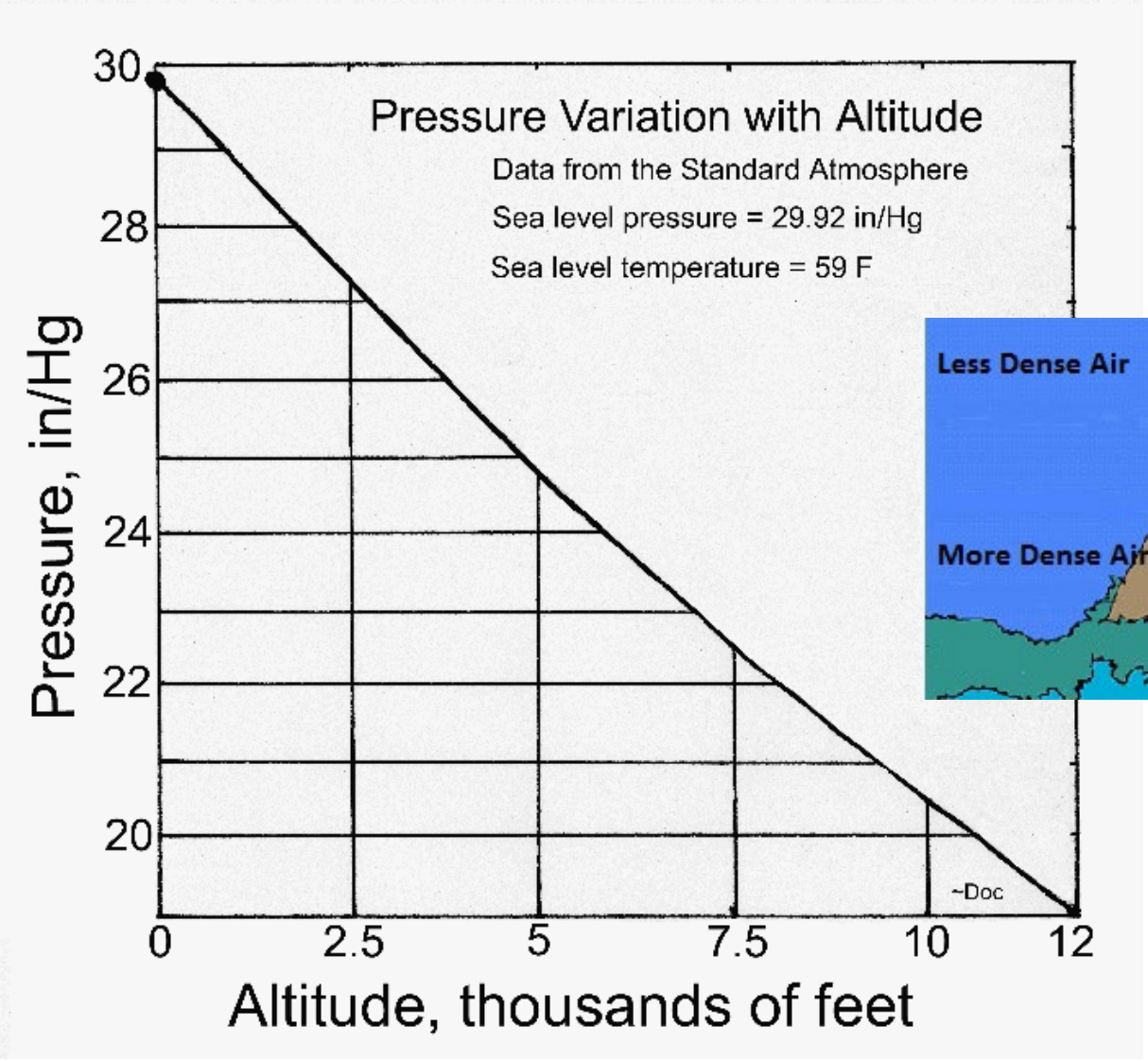


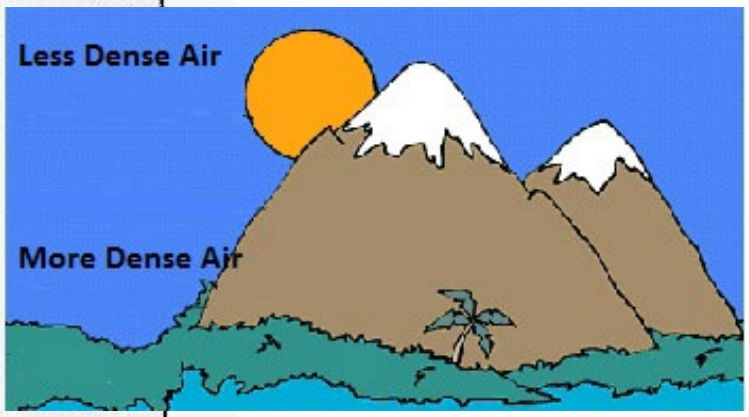
When a quadcopter is moving forward, it has a vertical force, horizontal force, drag and weight

Flying Faster increased Drag

However, at higher forward speeds, the aerodynamic drag on the quadcopter will start to increase, requiring extra power. High speed runs are even less efficient than hovering. There is a sweet spot of forward speed that will give you the most efficient flight and longest battery life.

Pressure Altitude

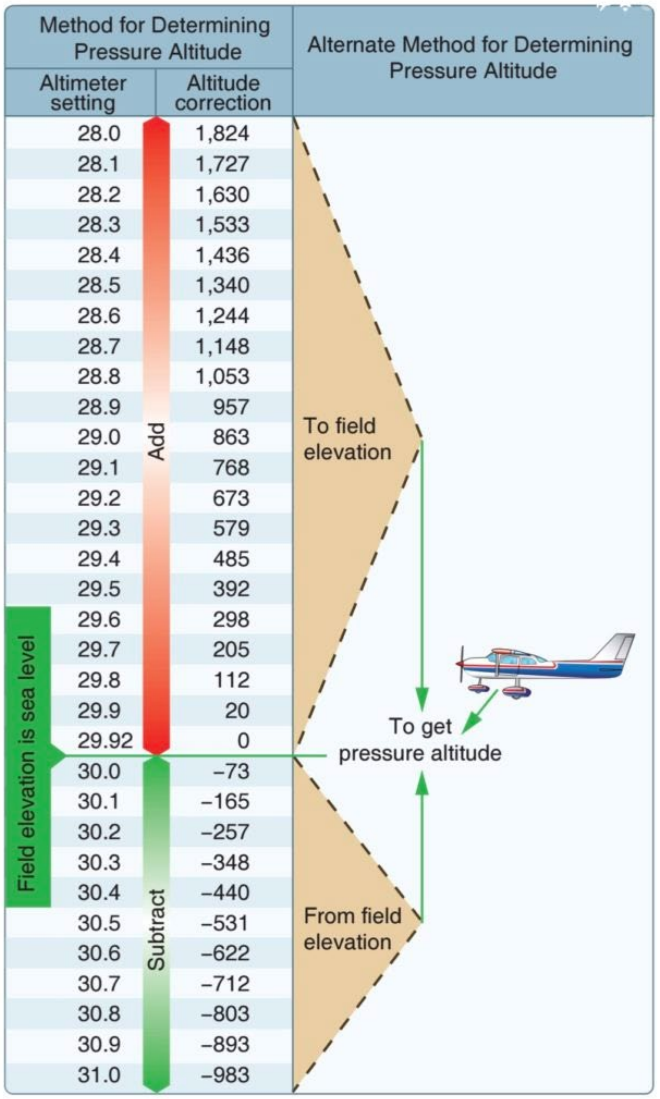




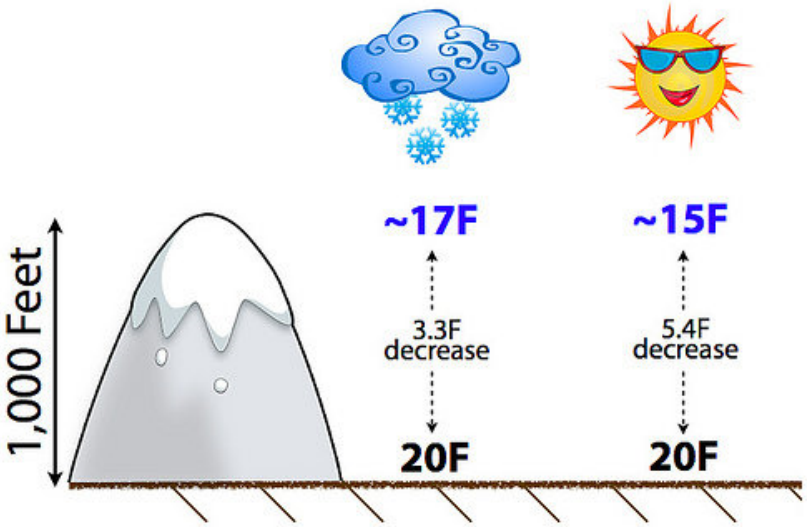
Pressure Altitude

Pressure Altitude is actual altitude adjusted for atmospheric pressure or barometer.

<u>Lower pressure</u> means lower air density which results in <u>reduced lift, thrust and internal combustion engine power</u>.



Temperature Change with Altitude



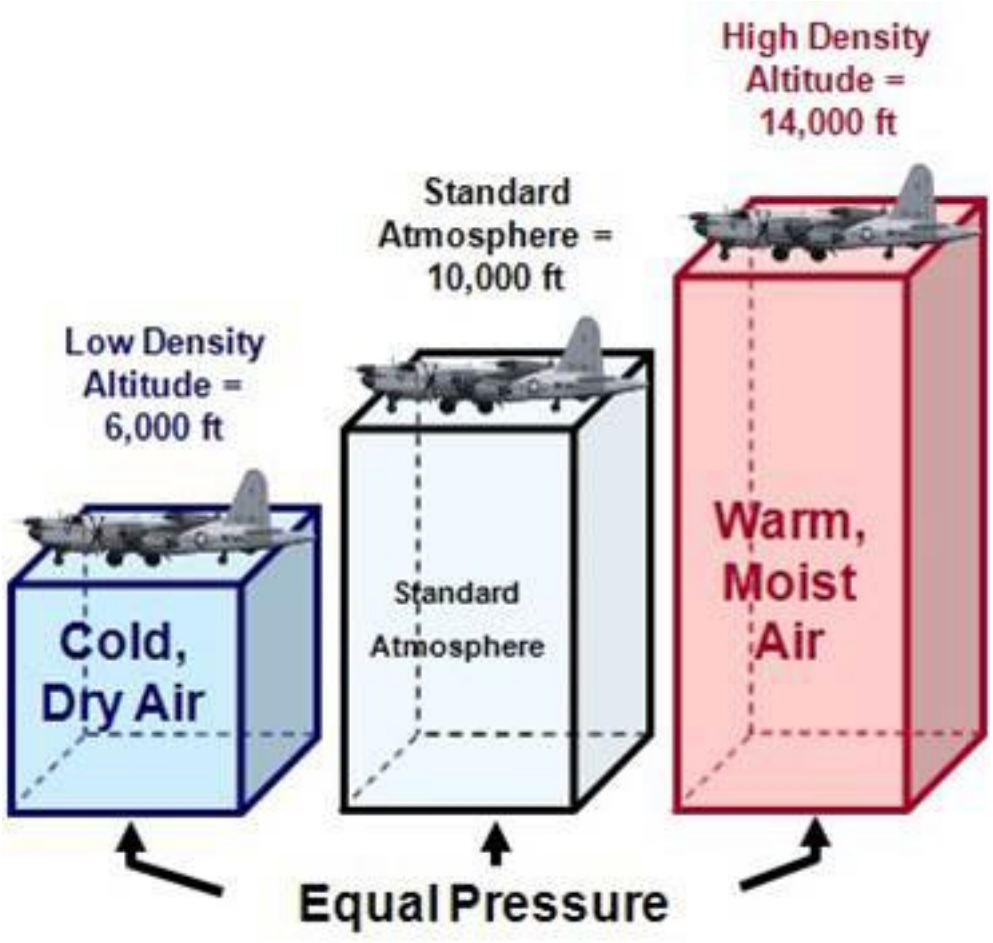
The air temperature will drop 3.3°F/1,000 feet (6°C/1,000 meters) in humid weather and 5.4°F/1,000 feet (9.8°C/1,000 meters) in low humidity weather.

Temperature Change with Altitude

Temperature can vary for several reasons: clouds or sun, in town or in the country, and inversions (colder air sinking because it's heaver than warm air) can all influence the temperature.

Low temperature means higher air density which results in increased lift, propeller thrust and internal combustion engine power.

Temperature Density



Hot air is less dense than cold air.

Effect of Humidity on Air Density

Water vapor is lighter than air; consequently, moist humid air is lighter than dry air. Therefore, as humidity increases, air becomes less dense, increasing density altitude and decreasing performance.

Density Altitude

Density Altitude is air density adjusted for temperature and barometric pressure given as height above sea level. "High density altitude" just means "high altitude". Air is thinner, so lift or propeller thrust is decreased.

In aviation, the density altitude is used to assess the aircraft's aerodynamic performance under certain weather conditions. In a sense, it's the altitude the aircraft "feels like" it is flying.

Temperature & Pressure Change

Both temperature and pressure decrease with altitude and have opposite effects upon air density. However, a rapid drop in pressure as altitude increases has a dominate effect. Hence, pilots can expect the density to decrease with altitude.

Density Altitude

Air density is perhaps the single most important factor affecting aircraft performance. It has a direct bearing on:

- The lift generated by the wings — reduction in air density reduces the wing's lift.
- The efficiency of the propeller or rotor — which is effectively an airfoil, behaves like lift on wings.
- The power output of internal combustion engines — power requires oxygen, so the engine power output is reduced at a higher density altitude.
- Electric motors are not affected by air density.

Density Altitude

The following lower the density of air and **increase density altitude**:

1) **lower barometric pressure**
2) **higher altitude**
3) **higher air temperature**
4) **higher humidity**

High density altitude is never a good thing for aircraft performance.

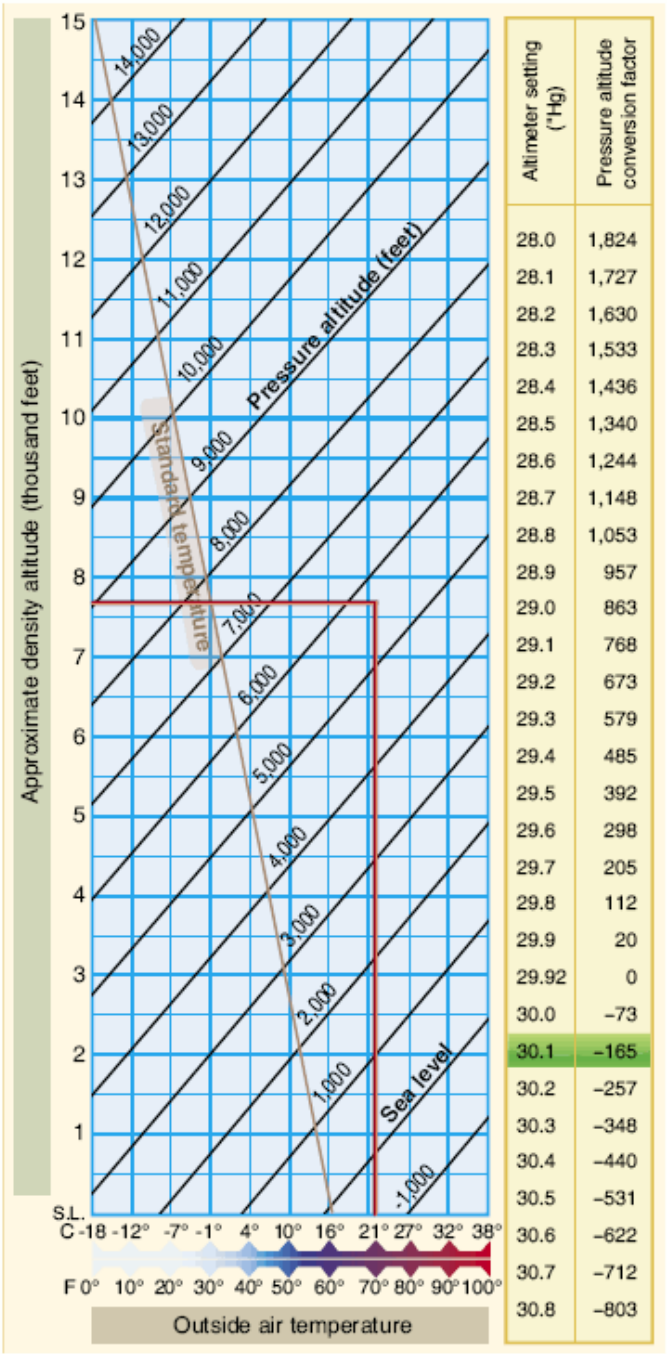
Density Altitude Calculation

Sample Problem

Airport Elevation……..5,883 feet

Outside Air Temperature (OAT)……70 °F

Altimeter……..30.10” Hg



Sample Test Question

What effect does high density altitude have on the efficiency of unmanned aircraft propellers?

A. Propeller efficiency is increased, and thrust is increased.

B. Propeller efficiency is decreased, and thrust is decreased.

C. Density altitude does not affect propeller efficiency or thrust.

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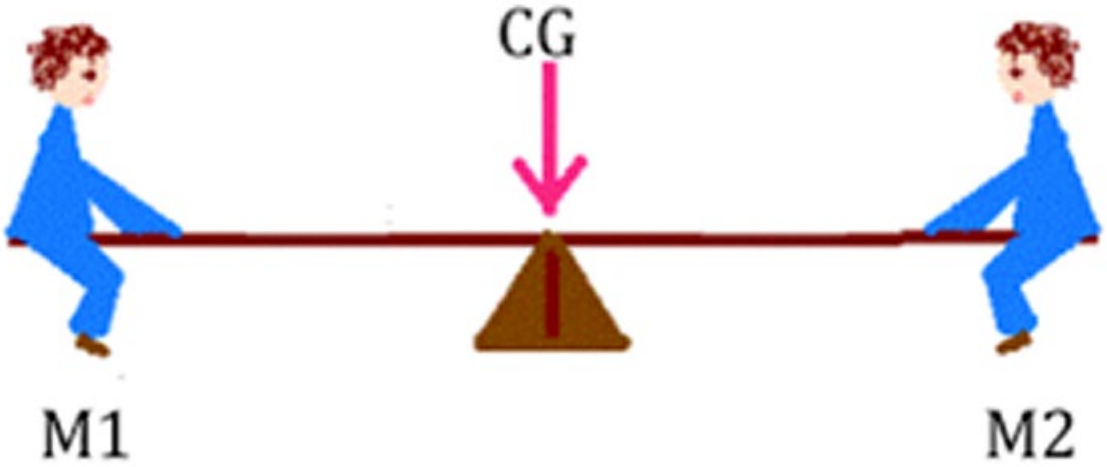
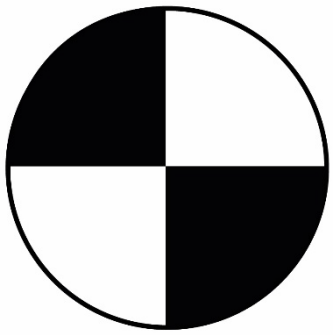
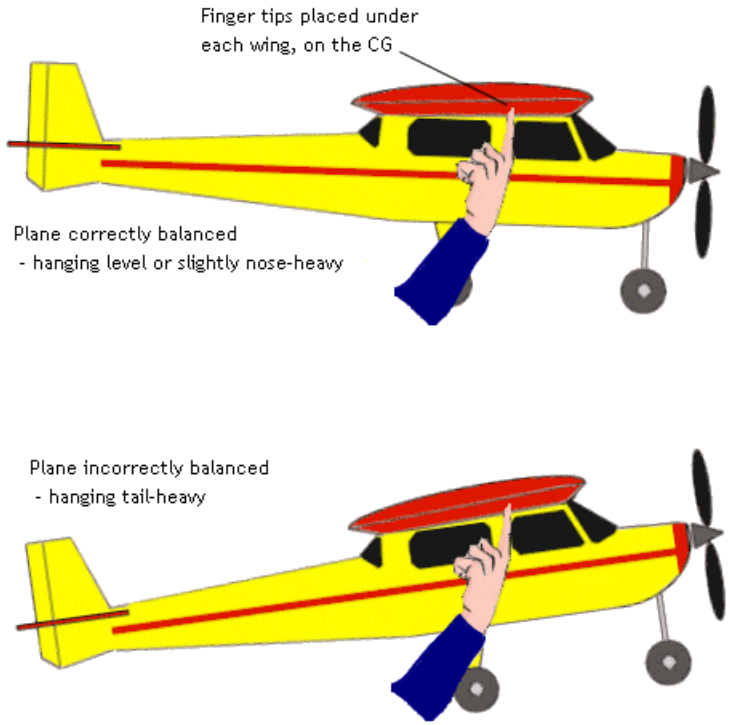
Center of Gravity (CG)



The Center of Gravity is a point from which the weight of a body or system may be considered to act. It is the same as the center of mass.



Center of Gravity (CG)

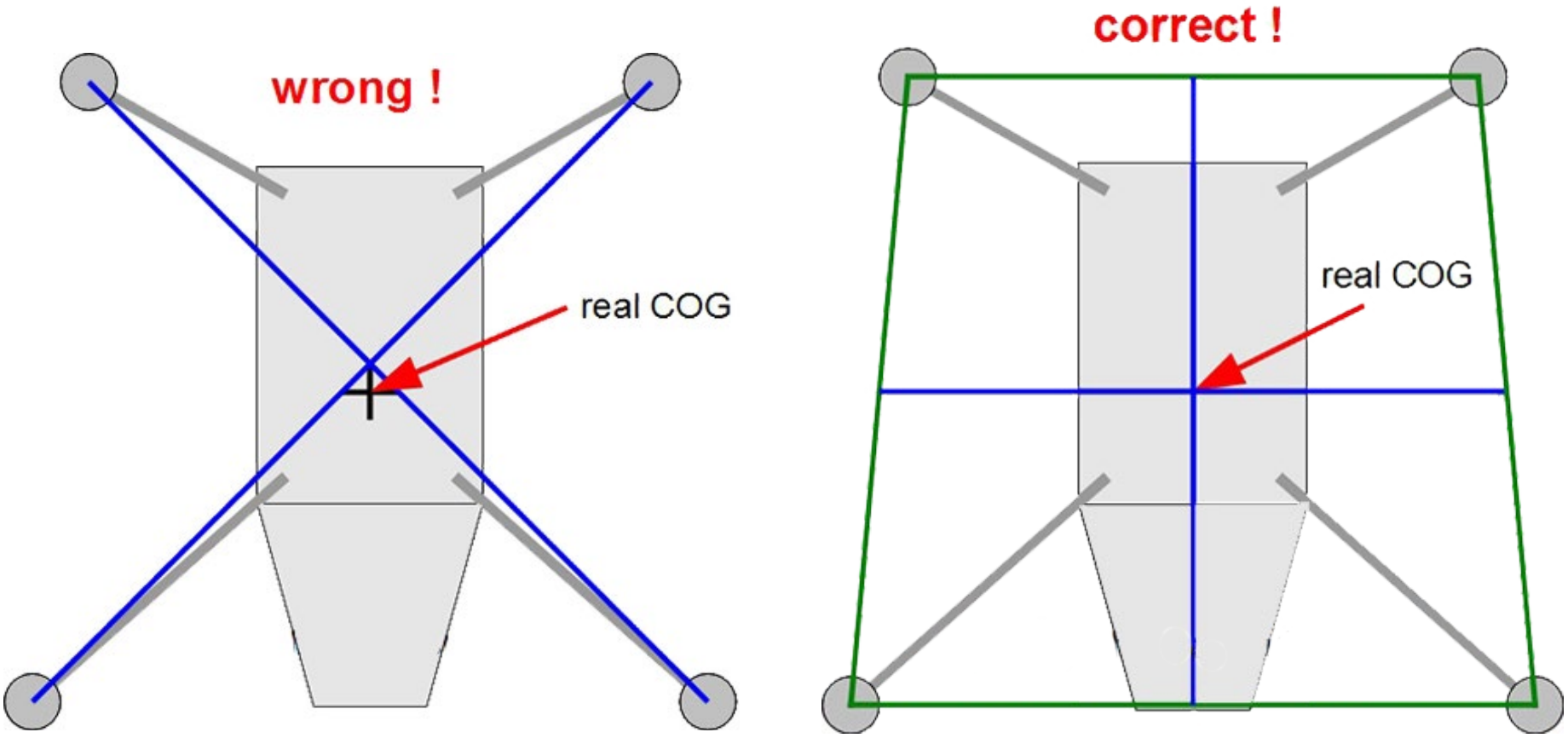


For a fixed wing aircraft, the Center of Gravity will be specified on the plans on in the instructions.

Center of Gravity (CG)

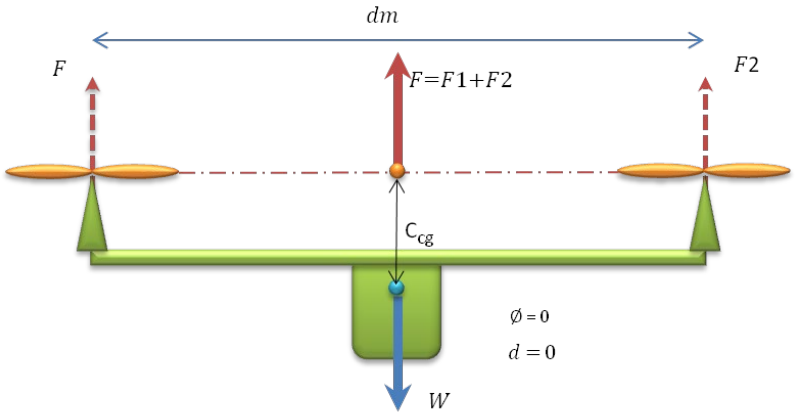
- **CG to far aft** – Aircraft will be “pitch sensitive”. Small elevator input result in large changes in pitch. The airplane can become unstable and uncontrollable! The pilot may not have enough elevator control to recover from a stall or spin.
- **CG to far forward** – Airplane will have increased stability but drag will increase due to increased angle of attack. Stall speed and landing speed will be higher.

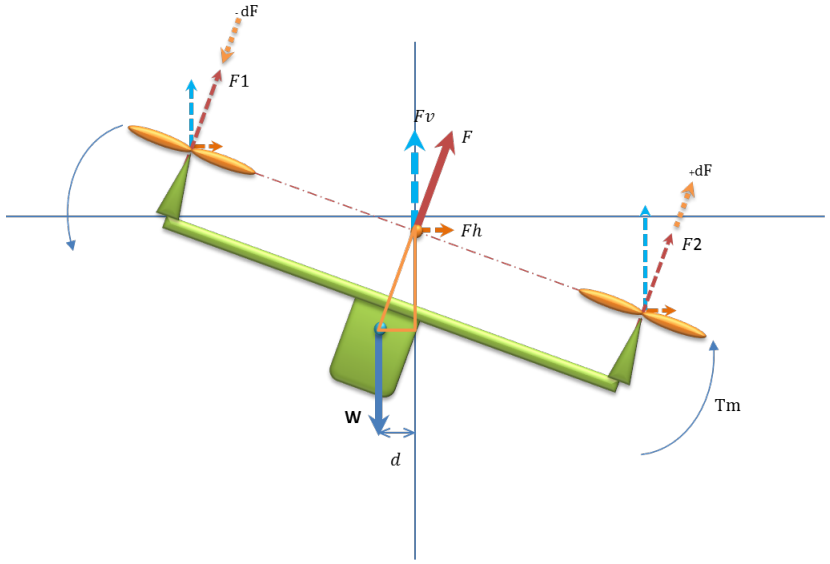
Center of Gravity (CG)



On a quadcopter or multicopter, the CG and the propeller center of thrust need to be aligned.

Center of Gravity (CG)





The vertical CG should be as close to the prop line as possible. If the CG is to far below the prop line, the quadcopter will have sluggish performance. If the CG is to far above the prop line, the quadcopter may be unstable.

Center of Gravity (CG)

Adding a camera or any other weight to a drone must be done without changing the CG alignment and without raising the vertical CG above the prop centerline.

Drone Weight

Weight is a critical factor in the design of drones. Most hobby drones are lightweight designs with limited excess motor power. A lightweight drone can fly longer with less battery consumption than heavier ones.

How much weight can a drone? It all comes down to power, size and weight. If no payload weight is specified, little or no extra payload can be carried.

Fixed Wing Weight

While many fixed-wing R/C aircraft are light weight designs, they can be designed to carry heavy weight.

Fixed wing R/C aircraft may have electric motors, glow fuel engines or gasoline engine. Some gasoline model airplane engines output 20 HP (15 kW) or more, far exceeding electric motor output.

Fixed-wing R/C aircraft can generally fly longer and further than multi-rotor drones.

Fixed Wing Excessive Weight

Excessive weight reduces the flight performance in almost every respect. The performance deficiencies of an overloaded aircraft are:

- Higher takeoff speed
- Longer takeoff run & longer landing rollout (longer runway needed!)
- Reduced climb rate & angle of climb
- Shorter flying time
- Reduced maneuverability
- Higher stall speed
- Higher landing speed

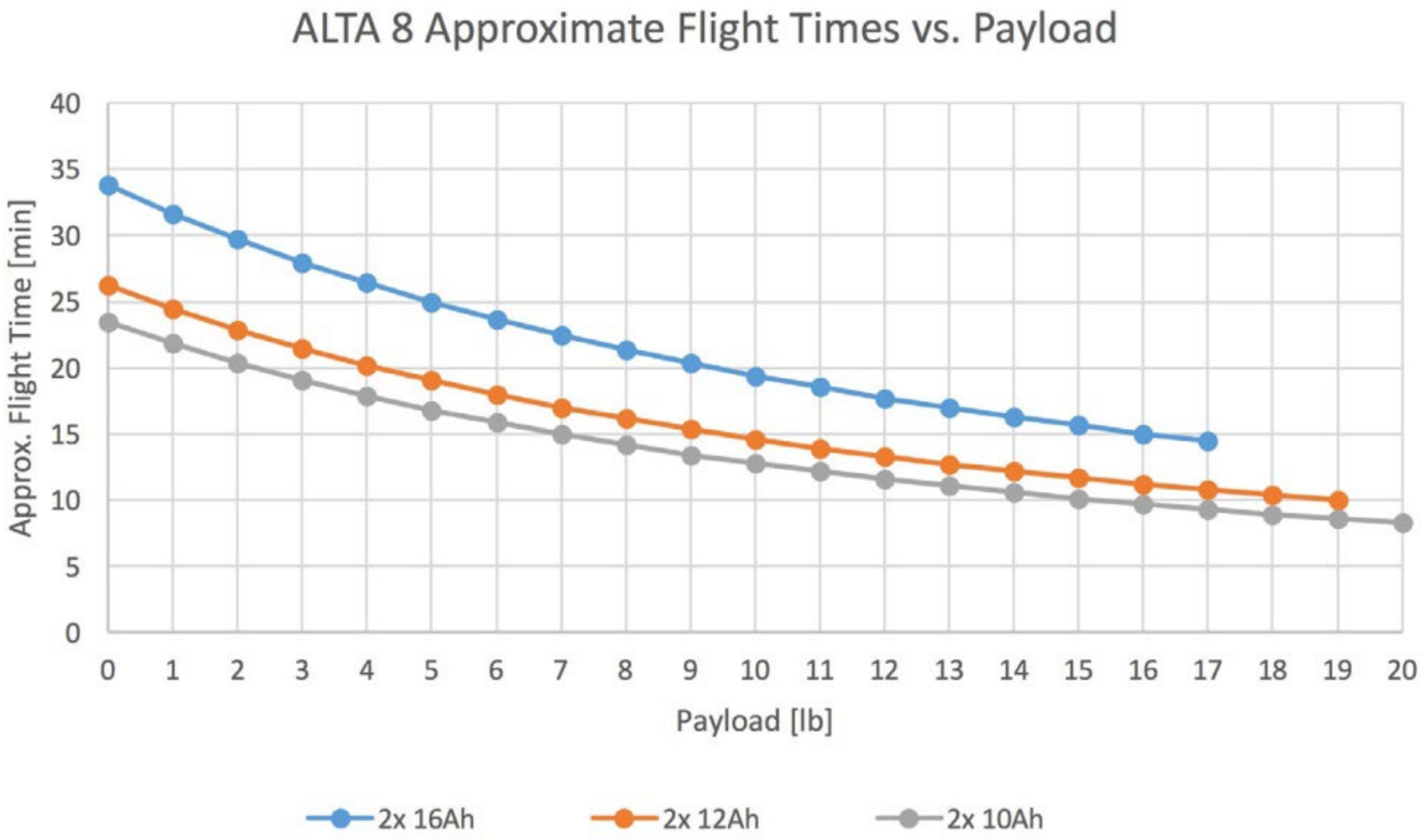
Quadcopter Excessive Weight

- Motors and Batteries may overheat
- Flight time is reduced
- Climb rate is reduced
- Stability is reduced
- Excess thrust available is reduced, which may result in a loss of control or a crash especially in windy conditions.
- If no information is available from the manufacturer, do not add weight to the drone.

Heavy Lift Drones
Alta 8 by Freefly Systems

Maximum Gross Weight = 40 lbs.
Maximum Payload Weight = 20 lbs.
Minimum Battery = (2) 6S 10,000 mAh LiPo
Propeller = 18x6 Price = $19,000

Flight Time vs. Weight



Altitude & Temperature Compensation

As altitude and temperature increase, air density decreases. Consequently, the quadcopters thrust will decrease. The following table describes maximum gross weight limits with respect to altitude and temperature.

Pressure Altitude (Ft)	0°C (32°F)		10°C (50°F)		20°C (68°F)		30°C (86°F)		40°C (104°F)	
	Maximum Gross Weight (lb)	Maximum Gross Weight (kg)	Maximum Gross Weight (lb)	Maximum Gross Weight (kg)	Maximum Gross Weight (lb)	Maximum Gross Weight (kg)	Maximum Gross Weight (lb)	Maximum Gross Weight (kg)	Maximum Gross Weight (lb)	Maximum Gross Weight (kg)
Sea Level	40.0	18.1	40.0	18.1	39.3	17.8	38.0	17.2	36.8	16.7
1000	40.0	18.1	39.3	17.8	37.9	17.2	36.7	16.6	35.5	16.1
2000	39.2	17.8	37.8	17.2	36.6	16.6	35.4	16.0	34.2	15.5
3000	37.8	17.2	36.5	16.5	35.2	16.0	34.1	15.5	33.0	15.0
4000	36.4	16.5	35.2	15.9	34.0	15.4	32.8	14.9	31.8	14.4
5000	35.1	15.9	33.9	15.4	32.7	14.8	31.6	14.3	30.6	13.9
6000	33.8	15.3	32.6	14.8	31.5	14.3	30.5	13.8	29.5	13.4
7000	32.6	14.8	31.4	14.2	30.3	13.8	29.3	13.3	28.4	12.9
8000	31.3	14.2	30.2	13.7	29.2	13.2	28.2	12.8	27.3	12.4
9000	30.2	13.7	29.1	13.2	28.1	12.7	27.2	12.3	26.3	11.9
10000	29.0	13.2	28.0	12.7	27.0	12.3	26.1	11.9	25.3	11.5

Payload Capacity

Unless specifically stated in the instruction manual, most drones are not intended to carry a payload. They do not provide flight time vs. weight charts or altitude & temperature compensation tables. However, their performance is affected by weight and environmental factors.

Example: increasing battery weight or adding a camera (even if recommended) will negatively affect a drone's performance.

V. **Operations** – 20 to 27 questions

1) Emergency procedures
2) Crew Resource Management (CRM)
3) Radio communication procedures
4) Physiological effects of drugs and alcohol
5) Aeronautical decision-making and judgment
6) Airport operations
7) Maintenance and preflight inspection procedures

FAA Aeronautical Knowledge Test

Part 107 Test

Operations – 15 questions

a) Airport operations
b) Radio communication procedures
c) Crew Resource Management (CRM)
d) Maintenance and preflight inspection procedures
e) Emergency procedures
f) Aeronautical decision-making and judgment
g) Physiological effects of drugs and alcohol
h) Operation at night

Flight Service Station(FSS)

Flight Service Stations provide pilots with weather and aeronautical information through pilot briefings, flight planning, inflight advisory services, weather cameras, search and rescue initiation, aircraft emergencies, and Notice to Air Mission (NOTAMs).

1-800-WX-BRIEF

1800WXBrief.com

- The FSS for Waterloo is in Fort Dodge

Communications

CTAF (Common Traffic Advisory Frequency) are the VHF radio frequencies used for <u>air-to-air</u> communication and <u>air-to-ground communication</u> at non-towered airports

CT is the Control Tower Frequency

***** means the frequency is not monitored 24/7

Communications

UNICOM (Universal Communications) provides air-to-ground communication at uncontrolled airports and provides ground-to-ground communication for non-flight services, such as requesting a taxi, even at towered airports.

MULTICOM – Pilots self-announce arrival and departures at uncontrolled airports without UNICOM on the MULTICOM, frequency of 122.9 MHz

Drone Communications

- sUAS pilots should not communicate with aircraft on CTAF (Common Traffic Advisory Frequency) but may monitor CTAF communications to know what aircraft are in the area.
- sUAS pilots may communicate with aircraft by UNICOM (Universal Communications) but it is not required.

Waterloo Airport (KALO)

CTAF	125.075
UNICOM	122.95
ATIS	120.65
WX ASOS	Phone: 319-233-8984
WATERLOO GROUND	121.9 [0600-2000]
WATERLOO TOWER	125.075 [0600-2000]
WATERLOO APPROACH	118.9 120.9 126.75
WATERLOO DEPARTURE	118.9 120.9 126.75
CLEARANCE DELIVERY	N/A
EMERGENCY	121.5

Sample Test Question

How would a remote PIC check for any NOTAMs in the area?

A) By utilizing the LAANC mobile application

B) By contacting the FAA district office

C) By obtaining a briefing from a Flight Service Station (FSS) at 1800WXBrief.com

Sample Test Question

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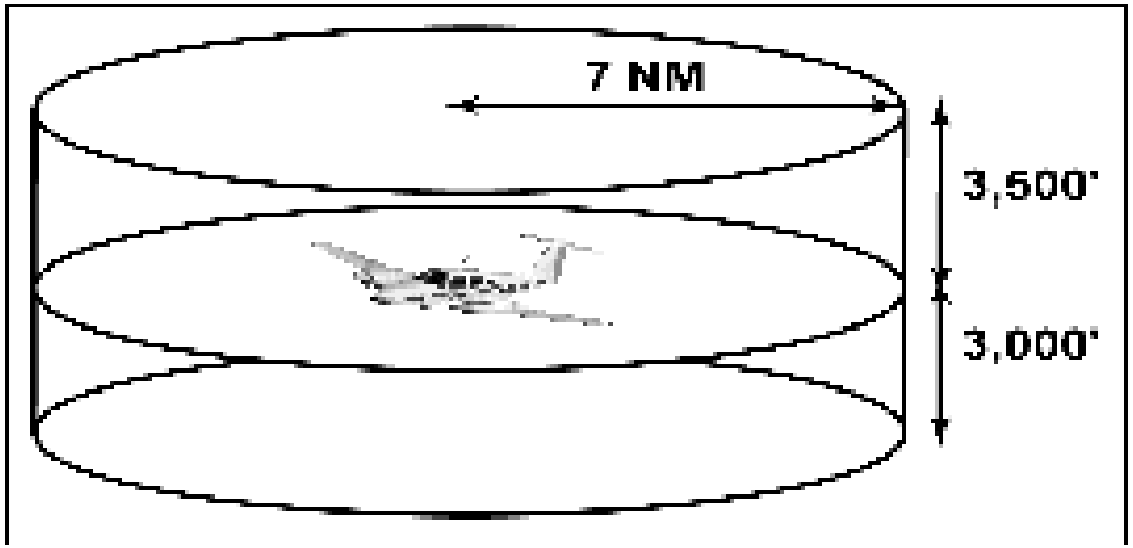
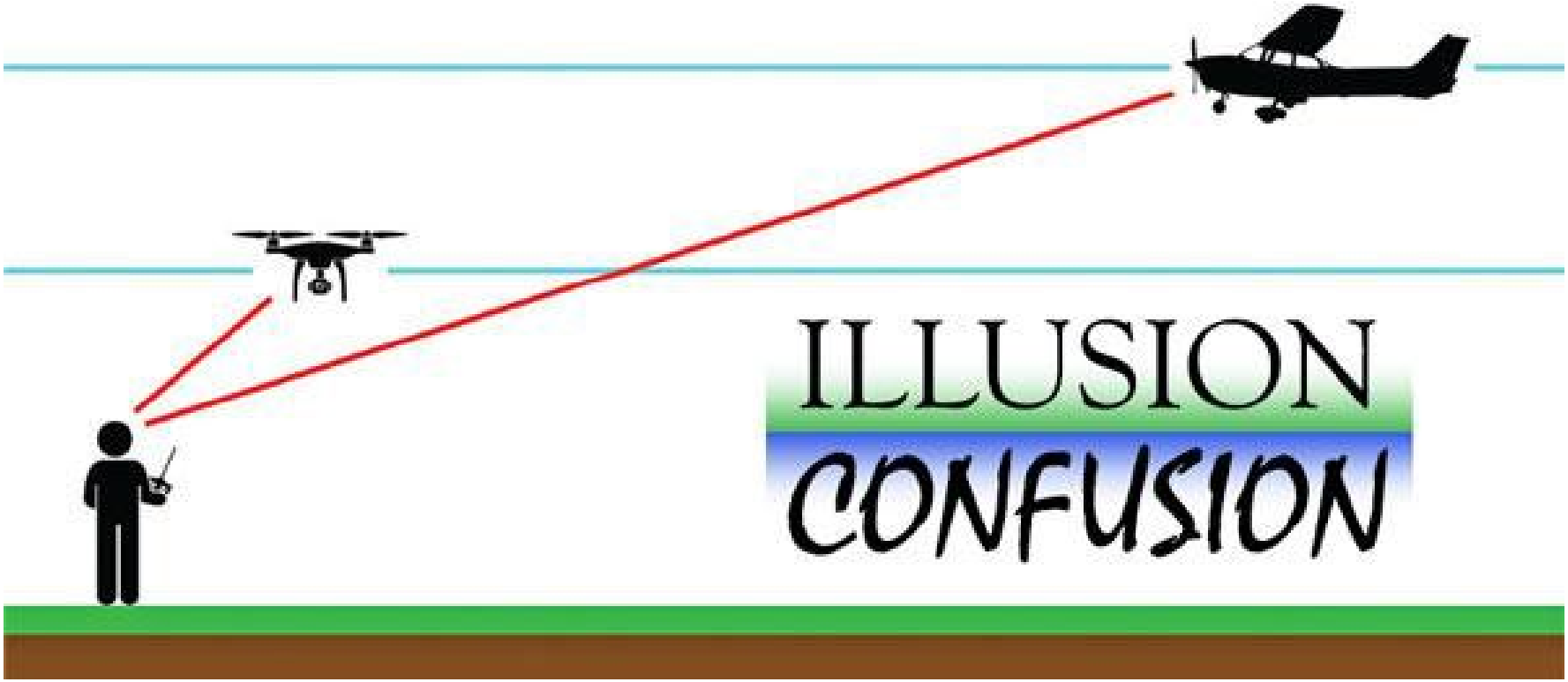
See and Avoid

A fundamental principle of flight safety is "see and avoid"




ILLUSION
CONFUSION

- In the preflight briefing, a drone pilot should ensure that any visual observer clearly understands the types of illusions and the two agree on clear and concise language to describe what each is seeing and what might be happening in the sky overhead.
- The best choice is the most conservative. The safest maneuver is simply to exit the airspace or fly to a protected area. Command the drone to hover next to a tree or in some other location where it's clearly out of the way. When you're operating your drone at long ranges, that's when these optical illusions are at their strongest.

Is the drone above or below the crewed aircraft? By how much?

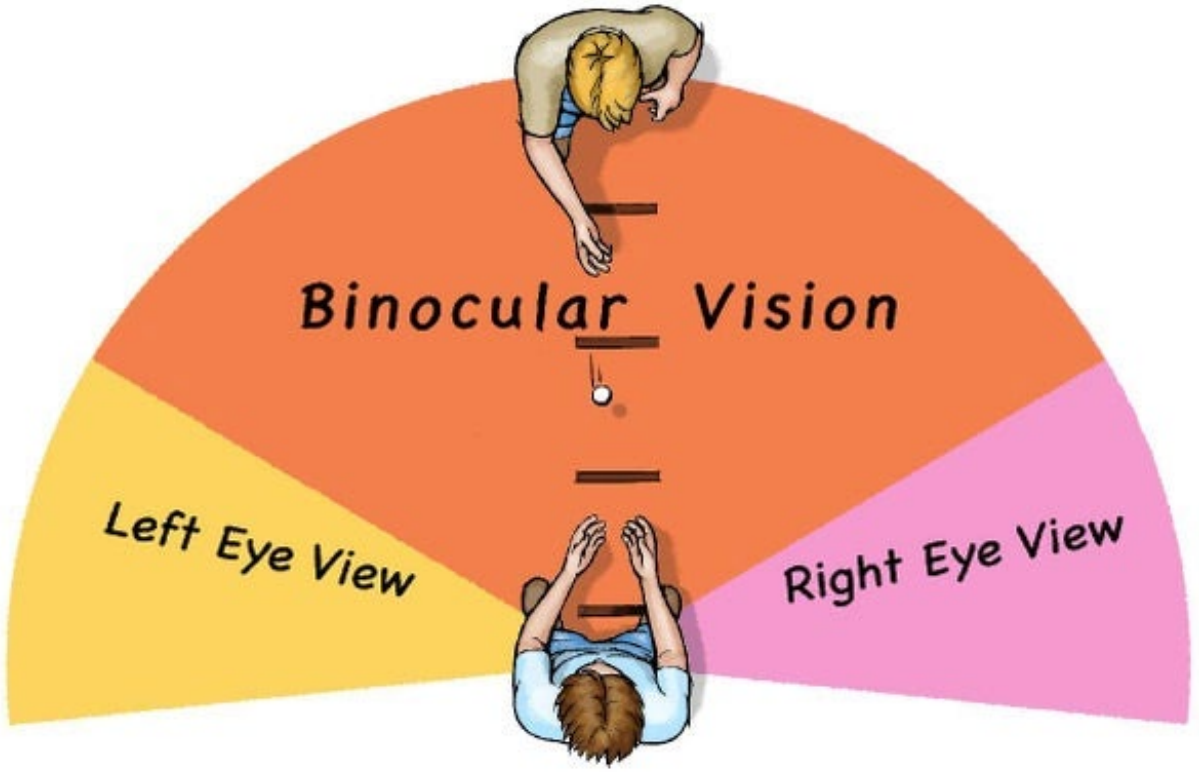
Image courtesy of FAA.

Is the drone above or below the oncoming crewed aircraft? By how much?
Image courtesy of FAA.

Is the drone above or below the crewed aircraft? By how much?

Image courtesy of FAA.

Depth Perception



Depth Misperception

Human depth perception only works at very short ranges, when there is sufficient difference between the angle of your eyes for your brain to detect distance.

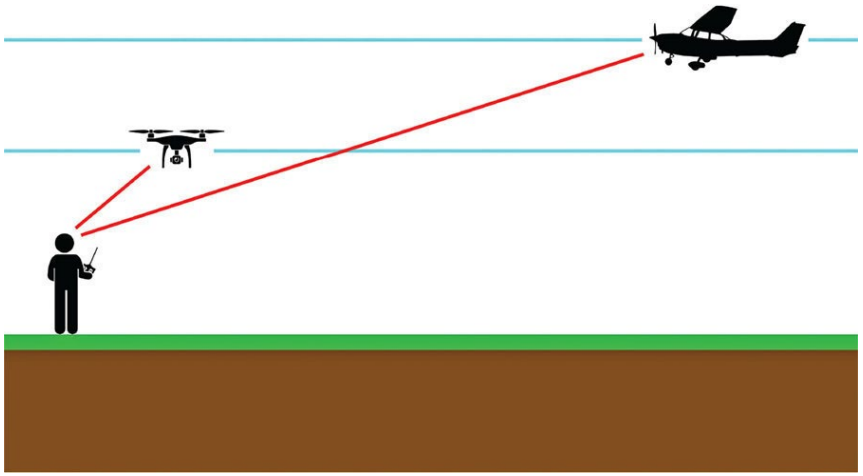
The limitation of the human vision system to perceive depth can create optical illusions at long range.

Statement by Adam Hendrickson, the lead investigator with the FAA's New Entrants Section (AFS-410C).

Down is Up

These optical illusions can be powerful, and in many cases, they can tempt the drone pilot to maneuver their drone closer to an approaching manned aircraft rather than away from it.

Our ability to determine the range to various objects, such as a drone and an oncoming airplane, is further degraded when we are making observations against a uniform background, such as the sky. Of course, the sky is precisely where drones and airplanes are most likely to be found.



Absent of any clear knowledge of which object is closer and which one is further away, our brain is likely to substitute another variable, such as the visual angle, to judge the relative altitude of the two objects. If the drone appears to be above the airplane in our field of view, as shown above, our brain assumes that the drone is at a higher altitude than the airplane. – *The drone is 100 feet below the airplane.*

The drone is 200 feet below the manned aircraft.

The drone is 100 feet below the manned aircraft.

Night Operations

- Night illusions
- Night physiology
- Diminished depth perception
- Collision avoidance
- Anti-collision lighting requirements

Twilight & Night Flying

A drone may fly in twilight or at night with lighted anti-collision lighting visible for at least 3 statute miles and a flash rate sufficient to avoid a collision.

Night is defined as:

30 minutes after sunset (evening twilight)

until

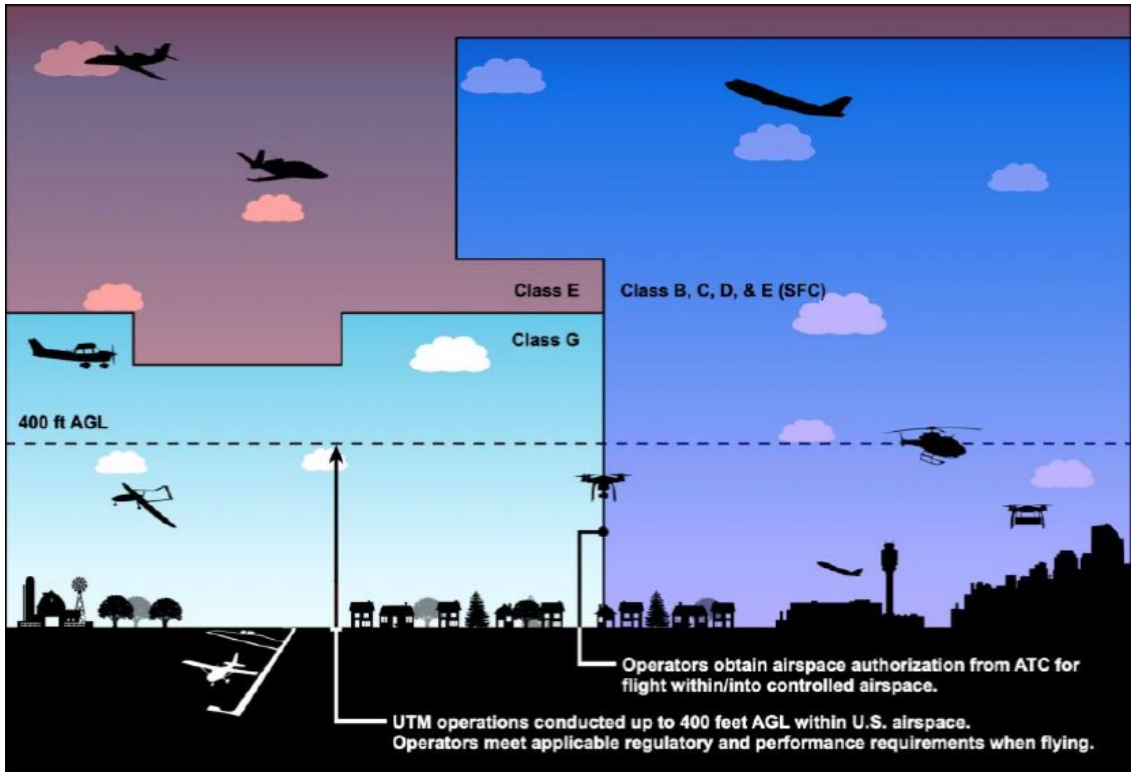
30 minutes before sunrise (morning twilight)

Twilight & Night Flying

The remote pilot in command may reduce the intensity of, but may not extinguish, the anti-collision lighting if he or she determines that, because of operating conditions, it would be in the interest of safety to do so.

Twilight & Night Flying

Night operations should only be flown in Class G airspace. All other areas require ATC authorization with LAANC or written authorization.



Night Flying Illusions

- **Autokinesis:** Phantom motion; protracted staring may cause the drone to appear to be moving, contrary to reality.
- **Fascination (Fixation):** Pilots ignore orientation cues and fix their attention on an object (the drone).
- **Reversible perspective illusion:** Inability to determine if the drone is moving towards you or away from you.
- **Size-distance illusion:** Dimly lit objects appear to be further away, and brightly lit objects appear closer.
- **Flicker Vertigo:** Flashing lights on the drone may cause nausea or disorientation.

Sample Test Question

When is civil twilight in the evening?

1) Twilight is the 30 minutes before sunset
2) Twilight is the 15 minutes before and the 15 minutes after sunset
3) Twilight is the 30 minutes after sunset

Sample Test Question

When is civil twilight in the evening?

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2) Twilight is the 15 minutes before and the 15 minutes after sunset
3) **Twilight is the 30 minutes after sunset**

Aeronautical decision-making (ADM)

Aeronautical decision-making (**ADM**) is decision-making in a unique environment—aviation. It is a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances. The goal of all flight crews is good ADM, and the use of Crew Resource Management (CRM) is one way to make good decisions.

Crew Resource Management (CRM) & Single-Pilot Resource Management (SRM)

CRM and SRM are defined as the art and science of managing all the resources available to a crew or single pilot (prior to and during flight) to ensure the successful outcome of the flight.

- Aeronautical decision-making (ADM)
- Risk Management (RM)
- Task Management (TM)
- Automation Management (AM)
- Controlled flight into terrain (CFIT) awareness
- Situational awareness (SA)

Preflight Checklist & Logbook

The Remote Pilot in Charge should do the following:

1. Check that all regulations and compliance requirements are being met
2. Inspect the drone and associated equipment for proper operation
3. Preflight Planning and Site Assessment
4. Safety Review
5. Post-Flight Assessment and Update Flight Log (there are no specific requirements for what's included in the Flight Log)

FAA Recommended Preflight checklist for the remote pilot in command

a) Assess the operating environment, considering risks to persons and property in the immediate vicinity both on the surface and in the air. This assessment must include:
   1) Local weather conditions;
   2) Local airspace and any flight restrictions;
   3) The location of persons and property on the surface; and
   4) Other ground hazards.
b) Ensure that all persons directly participating in the small unmanned aircraft operation are informed about the operating conditions, emergency procedures, contingency procedures, roles and responsibilities and potential hazards;

FAA Recommended Preflight checklist for the remote pilot in command

c) Ensure that all control links between ground control station and the small unmanned aircraft are working properly;

d) If the small unmanned aircraft is electric powered, ensure that there is enough battery capacity to operate for the intended operational time;

e) Ensure that any object attached or carried by the small unmanned aircraft is secure and does not adversely affect the flight characteristics or controllability of the aircraft; and

f) If the operation will be conducted over human beings, ensure that the aircraft meets the applicable requirements.

Preflight Checklist

- ✓ Visual inspection of the drone airframe and components – All equipment securely attached
- ✓ Check registration markings
- ✓ Inspect propellers for nicks or damage
- ✓ Batteries fully charged
- ✓ Radio link from Transmitter to Drone is connected
- ✓ Radio range check
- ✓ Check Compass & GPS Calibration

Preflight Checklist & Logbook

- ✓ Check onboard navigation and communication telemetry links
- ✓ Is Display functioning properly?
- ✓ Ground support equipment, including takeoff and landing equipment in place
- ✓ Verify and note any obstructions that may interfere with the drone's flight path
- ✓ Return to Home set
- ✓ Start the motors to inspect for any propeller imbalance or irregular operation

Maintenance Schedule

You're supposed to have one, even though most drones have few serviceable parts, and a maintenance schedule is not provided.

FAA recommends you create a schedule based on your flying experience. Are there parts that need to be regularly checked and periodically replaced (e.g., propellers and batteries)?

Use Preflight Checklist and Logbook info to create a maintenance schedule.

What are you required to record in your logbook?

A) Time, Date, Flight Duration, Weather Conditions, Drone Name, Names of all people in the Flight Crew.

B) Time, Date, Flight Duration, Weather Conditions, Drone Name.

C) Time, Date, Weather Conditions, Drone Name.

D) Nothing, a logbook isn't required for Part 107 Pilot.

What are you required to record in your logbook?

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START
Identify Hazards
Assess Risks
Analyze Controls
Make Control Decisions
Use Controls
Monitor Results
RISK MANAGEMENT PROCESS

Emergency Procedures

Despite our best intentions, sometimes *things just go wrong*.

1. **Fly First! Maintain or regain aircraft control –** Always maintain visual contact with the aircraft during an emergency to reduce the likelihood of disorientation.
2. **Analyze the situation –** *The most dangerous situation is one that's both serious and requires immediate action.*
   - What's wrong?
   - How critical is it?
   - How much time do I have?
3. **Take appropriate action –** Always consider the safety of yourself and others before attempting to save the aircraft in an emergency.
   - If a problem coincides with something you did, undo it!

Test Question

Prior to a flight requiring a visual observer, the PIC and the VO go over the mission so that each know what to expect, and what to be alert for. This kind of planning is an example of:

1) Safety Management (SM)
2) Crew Resource Management (CRM)
3) Team Communications (TC)
4) Operational Planning (OP)

Test Question

Prior to a flight requiring a visual observer, the PIC and the VO go over the mission so that each know what to expect, and what to be alert for. This kind of planning is an example of:

1) Safety Management (SM)
2) **Crew Resource Management (CRM)**
3) Team Communications (TC)
4) Operational Planning (OP)

Hazardous Pilot Attitudes

1) **Resignation** – *"What's the use? I give up!"*
   Antidote: *"I'm not helpless. I can do this!"*
2) **Anti-Authority** – *"Why should I listen to you?" "Nobody can tell me what to do!"*
   Antidote: *"Follow the Rules. They are usually right."*
3) **Impulsivity** – *"Do it Quickly or Without Thinking!"*
   Antidote: *"Not so Fast. Think first."*
4) **Invulnerability** – *"Nah I don't think it'll happen to me!"*
   Antidote: *"It could happen to me!"*
5) **Machismo (Macho)** – *"Come on! I can do this!"*
   Antidote: *"Taking chances is foolish."*

Hazardous Pilot Attitudes

A drone pilot is showing off his flying skills performing potentially hazardous maneuvers to impress friends. This is an example of:

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Situational Awareness

Look – Think – Act

1. See everything in the environment that may affect your flight - Look
2. Comprehension of current situation - Think
3. Projection of future status - Act

SITUATIONAL AWARENESS

Needs improvement.

Sample Test Question

Aeronautical Decision Making (ADM). Safety is an important element for a remote pilot to consider prior to operating an unmanned aircraft system. To prevent the final "link" in the accident chain, a remote pilot must consider which methodology?

A) Crew Resource Management (CRM)

B) Safety Management System (SMS)

C) Risk Management

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Sample Test Question

When adapting crew resource management (CRM) concepts to the operation of a small UA, CRM must be integrated into:

A) the flight portion only

B) all phases of the operation

C) the communications only.

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Safety Rules – Drugs & Alcohol

"A person manipulating the flight controls of a small unmanned aircraft system or acting as a remote pilot in command (PIC) or visual observer (VO) must comply with the provisions of §§91.17 and 91.19 of this chapter." 14 CFR Sec. 91.17 says,

- *No person may act or attempt to act as a crewmember within 8 hours after the consumption of any alcoholic beverage or while under the influence of alcohol;*
- *While using any drug that affects the person's faculties in any way contrary to safety; or*
- *While having an alcohol concentration of 0.04 or greater in a blood or breath specimen.*

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- *No person may operate a sUAS within the United States with knowledge that narcotic drugs, marihuana and depressant or stimulant drugs or substances as defined in Federal or State statutes are carried in the aircraft.*

Sample Test Question

Which is true regarding the presence of alcohol within the human body?

A) A small amount of alcohol increases vision acuity.

B) Consuming an equal amount of water will increase the destruction of alcohol and alleviate a hangover.

C) Judgment and decision-making abilities can be adversely affected by even small amounts of alcohol.

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Frequently Failed Questions

- sUAS weight limitations
- sUAS Display of registration
- sUAS Flying distance from clouds
- sUAS waivers
- Visual Line of Sight (VLOS)
- Operation of multiple sUAS
- Operation over humans
- Condition for Safe / Hazardous Operation
- Prescription & over-the-counter drugs
- Dehydration / Heat Stroke

By the Numbers

- ✓ **1**. The number of drones you can fly simultaneously.
- ✓ **400 feet**. The maximum height you can fly AGL or above a taller building within a 400-foot radius.
- ✓ **100 MPH / 87 Knots**. Fastest you can fly.
- ✓ **0.55 lbs**. The lightest drone that must be registered. (Drones weighing less than 0.55 lbs. or 250 grams do not need to be registered.)
- ✓ **55 lbs**. Heaviest legal sUAS drone (must be less than, not equal to, 55 lbs.).
- ✓ **0.04**. Maximum blood alcohol level.
- ✓ **8 hours**. The time that must pass since you have had alcohol.
- ✓ **$500**. The repair cost of accident damage that requires you to report an accident to the FAA

By the Numbers

- ✓ **10 days**. The maximum time you can take to file an FAA accident report.
- ✓ **14 days.** If you change your address, the time you have to update your drone registration.
- ✓ **30 days**. If you change your address, the time you have to update your Part 107 remote pilot certificate.
- ✓ **90 days**. The lead time required when requesting a written FAA waiver.
- ✓ **1 year.** Time that must pass after a final narcotics conviction.
- ✓ **13 years old.** The youngest person who can register a recreational drone.
- ✓ **16 years old**. The minimum age to obtain a Remote Pilot certificate
- ✓ **24 months**. How long this Remote Pilot certification is good for.

By the Numbers

- ✓ **30 minutes**. The twilight time before sunrise or after sunset when you can still fly.
- ✓ **3 statute miles**. The distance your anti-collision lights must be visible from when flying during twilight. Also, the minimum visibility you must have while flying.
- ✓ **500 feet**. Minimum number of feet below a cloud you must fly.
- ✓ **2,000 feet**. Minimum number of feet horizontally from a cloud you must fly.
- ✓ **122.9 MHz**. The MULTICOM frequency for self-announce procedures.
- ✓ **1000 feet.** The minimum ceiling to fly in Class E airspace
- ✓ **2000 feet**. The distance you should operate from a tower to avoid hitting guy wires.

- **Remote Pilot in Charge**. This is the answer to any question about who is responsible.
- **Left**. Aircraft always turn left when circling a runway, because drivers sit on the left side of the car in the US, and pilots sit on the left of the plane, too. It's easier for them to look out the left window to see the tower.
- **CTAF vs UNICOM vs MULTICOM vs ASOS/AWOS**.
  - ASOS & AWOS are weather.
  - CTAF is for pilots to talk to each other when there's no tower. UNICOM is a base station that broadcasts to pilots when there's no tower.
  - MULTICOM (122.9) is used as the CTAF when there's no CTAF.

Other Information

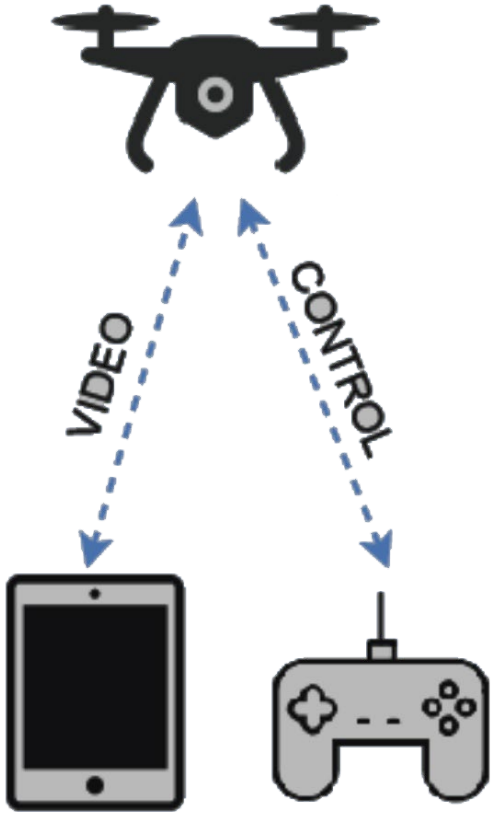
Good to know, but not on the test.

FCC License for Video Broadcasting

Drones broadcast two signals –

A) **Radio control** signal to the drone – usually 2.4 GHz band

B) **Video signal** to monitor or goggles – usually 5.8 GHz band



Video systems typically use 5.8 GHz

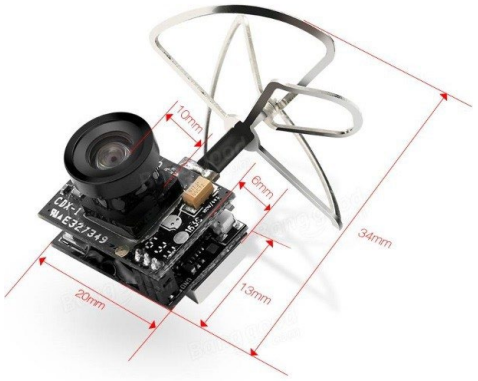
- The 5.8 GHz frequency band is made up of 300 channels, each channel is 1 MHz wide
- Video signals need a continuous stream of data with a 35 MHz to 40 MHz of band separation
- Video signals operating in the same RF environment as R/C transmitters will have interference (static, snow or ghosting) or even loss of signal
- Using 5.8 GHz for FPV will give a much cleaner video image than 2.4 GHz, but have a shorter range

Latency

- “Delay”, “latency” and “lag” are all terms used to describe the amount of time it takes from your drone’s video camera to capture an image and send it to be displayed on your screen.
- Analog video cameras have 20ms-40ms delay. HD digital video cameras such as GoPro have 100ms-140ms delay.
- FPV racing cameras transmit a low-quality standard definition (SD) analog signal for low latency.
- The faster you fly the bigger the impact of latency. A 100ms delay when flying at 50 mph can mean your drone will travel about 1.7m (5 ½ feet) before you see the video.

Video Broadcast Channels

- The 5.8 GHz frequency range is divided into bands with 8 channels in each band.
- Different manufacturers choose different channels and channel spacing.
- Most manufacturers have standardized on the “Race Band” or “Band C”



Race Band

8 channels spaced 37 MHz apart

Channels	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
Race Band	5658	5695	5732	5769	5806	5843	5880	5917
Frequency MHz	5.685	5.695	5.732	5.769	5.806	5.843	5.880	5.917

Video System Range

- Wi-Fi – 2.5 miles @ 2.4 GHz
- Wi-Fi – 1.2 miles @ 5.8 GHz
- Lightbridge – 4.3 miles @ 2.4 GHz
- Lightbridge 2.0 – 3.1 miles @ 2.4/5.8 GHz
- OcuSync – 4.3 miles @ 2.4 GHz
- OcuSync 2.0 – 6.2 miles @ 2.4/5.8 GHz
- OcuSync 3.0 – 7.5 miles @ 2.4/5.8 GHz
- Autel EVO – 4.3 miles @ 2.4 GHz

Video Transmitter (VTX) Power

- 25 mW – good for micro drones & indoor racing with many racers – **no license required**
- 200 mW – good for outdoor racing – **FCC license required**
- 600 mW – good for solo flying – maximum power and range – **FCC license required** – more prone to multi-pathing

mW = milliWatt or 1/1000 of a watt

FCC = Federal Communications Commission Amateur Radio Operators License (HAM)

FCC HAM License

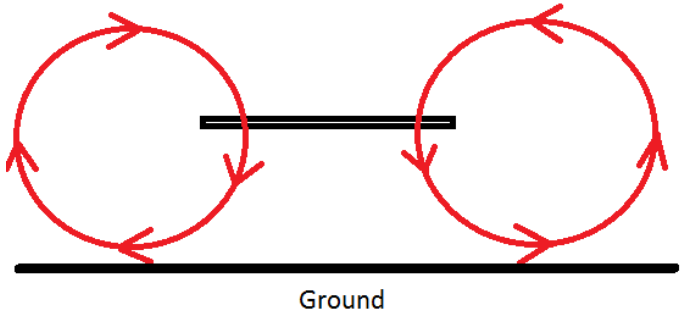
Volunteer Exam Coordinators (VECs) are members of HAM radio clubs and are approved by the FCC to administer the exam. Some HAM clubs offer the test online.

The **Technician License** is the lowest level license and it's all you need for drone video broadcasting.

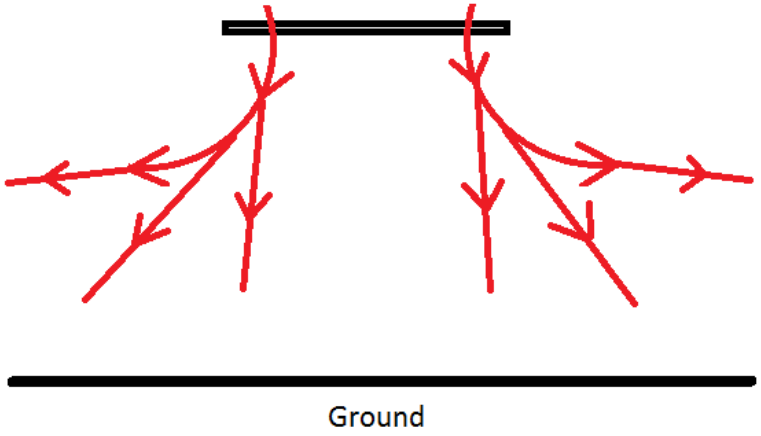
The local HAM radio club is the **Northeast Iowa Radio Amateur Association**. They meet monthly at the and their web page is: https://w0mg.net/

HAM radio clubs belong to the Amateur Radio Relay League (ARRL).

Ground Effect

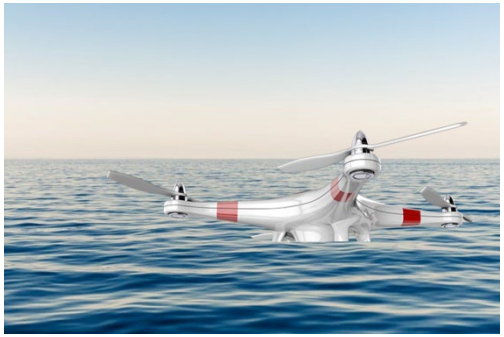


At low altitude turbulent air recirculates back into the quad blades. This reduces the power consumption but decreases stability.



At higher altitudes “clean” air is drawn into the quad blades. This increases the power requirement and increases stability.

Strange but True



You are quickly descending your quad from altitude. You try to slow the descent by applying some throttle, but instead of slowing, it starts to wobble in the air. You apply more throttle to stop the descent, but that just makes it wobble and drop even faster. You're finally at full throttle as it smashes into the ground, or worse yet, a lake or river.

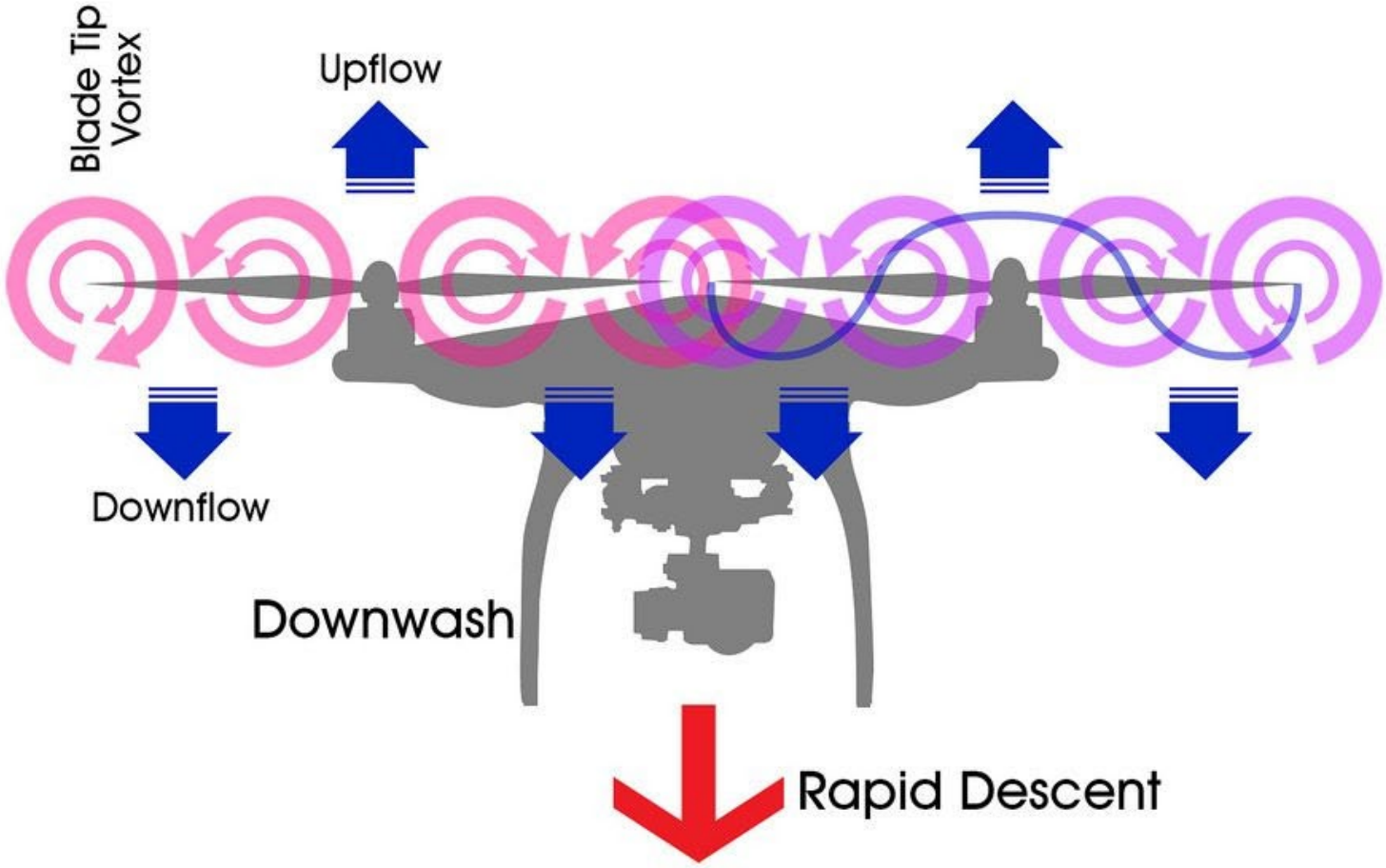
Strange but True

Vortex Ring State (aka “settling with power”, “blade stall” or “the wobble of death”) is a hazardous condition common to all quads and helicopters. It occurs when three things occur at the same time: a high rate of descent, slow or no forward airspeed, and the copter or drone is using a large portion of its available power. It is more likely to occur if the drone is over-weight.

This is why full-size helicopters “fly” the approach to a landing pad and then hover land the final few feet.

Quadcopter Vortex Ring State

Settling with Power



Vortex Ring State

Bell Boeing V-22 Osprey

Landing Approach

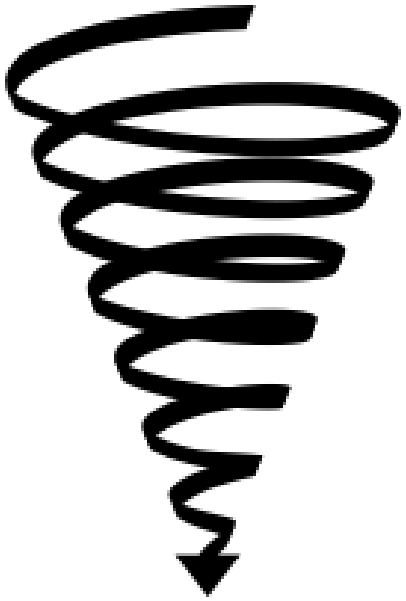
The best and safest drone landing approach is to fly to the landing zone like an airplane, slowly decreasing throttle while flying toward the landing zone.

When the drone is in the ground effect, flare into a hover and land.

In most cases, this will avoid the Vortex Ring State problem.

RAPID DESCENT

To make a rapid descent from high altitude, fly the drone in a downward spiral until you can make a normal landing approach.



Drone Insurance

- If you're flying commercially, drone liability insurance could save you a lot of money if an accident happens.
- Getting drone insurance may also help you get clients, who may not want to work with you unless you're insured.
- Your homeowner's or business' liability insurance may NOT cover the use of your drone, even if you're operating recreationally in your own backyard.
- A $1 million commercial liability policy for a DJI Phantom 4 runs $500-$750 a year. For $5-$10/hour, you can buy $1 million in liability coverage from an on-demand drone insurance company (SkyWatch or Verifly).
- AMA offers commercial drone insurance policies. AMA membership includes $2.5 million in liability insurance for recreational drone flyers.


Any
Questions